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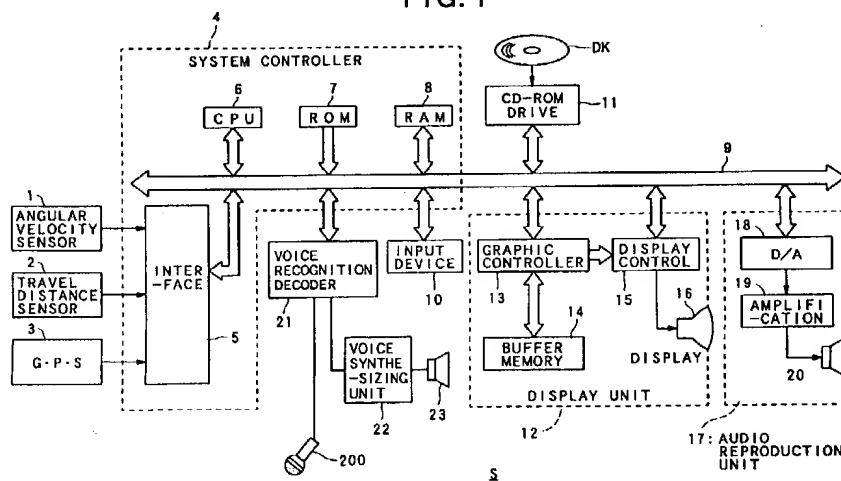
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(54) **Apparatus for and method of retrieving information**

(57) An information retrieving apparatus (S) is advantageously used in a voice operation of a vehicle navigation system. The apparatus includes a storage unit (DK, 8) for storing the plural pieces of the candidate information composing a hierarchical structure including m hierarchies (m is a natural number not less than 2), and the apparatus retrieves a target information from the hierarchical structure. The apparatus includes an input unit (200) for inputting information, a judging unit

(6) for judging a correspondence of the inputted information with one of the plural pieces of the candidate information and for judging the hierarchy of the candidate information if the correspondence is obtained, and a retrieving unit (6) for retrieving one of the plural pieces of the candidate information as a target information based on a judged result of the judging unit.

**FIG. 1**



## Description

### Field of the Invention

[0001] The present invention relates to a technical field of an information retrieval apparatus for retrieving information such as a destination spot in a navigation device which displays a travel route of a mobile object such as a vehicle, names of famous places around the travel route and the like as well as a map so as to assist the driving of the mobile object.

### Description of Related Art

[0002] At present, there is known a navigation device, which displays a position mark (guide mark) representing a current position of a mobile object on a map so as to guide a travel route to a destination spot based on the displayed map, as a position measuring device used for various mobiles such as a vehicle, an aircraft and a vessel. In such navigation devices, vehicle navigation devices to be mounted on vehicles are roughly divided into two types: a stand-alone type navigation device and a GPS (Global Positioning System) type navigation device.

[0003] The stand-alone type navigation system obtains a travel direction and a travel distance of a vehicle by means of independent sensors such as a speed sensor and an angular velocity sensor provided on the vehicle, and then calculates a current position of the vehicle by successively adding the obtained travel direction and travel distance to a reference point so as to display a position mark and a corresponding map on a display screen based on the calculated current position.

[0004] The GPS type navigation system receives a position measuring radio waves from a plurality of GPS satellites launched into space via a GPS receiver, and calculates a current position of the vehicle by a three-dimensional measuring method or a two-dimensional measuring method based on the received result so as to display a position mark and a corresponding map on a display screen based on the calculated current position.

[0005] Further, a so-called hybrid-type vehicle navigation device having both functions of the above-mentioned stand-alone type and GPS types navigation systems is recently known.

[0006] In addition, among the above respective vehicle navigation devices, there is also known a navigation device for superposing a scheduled travel route, which the vehicle plans to follow, on a map to be displayed together with famous places around the travel route.

[0007] According to the above respective vehicle navigation devices, since a user (i.e., driver) can know a current position of the vehicle and a map around the current position in connection with each other, he or she can reach the destination without getting lost even if he or she goes to the area for the first time.

[0008] On the other hand, in the above-mentioned

vehicle navigation device, there is a case, for example, that the driving is started after a destination spot is set and a travel route to the destination spot is determined in advance. At this time, in setting the destination spot, a plurality of destination candidates are arranged in a hierarchical data structure, and the particular destination spot is set by successively searching the hierarchical structure for that particular destination in an interactive manner with the user.

[0009] Namely, according to the vehicle navigation device having the destination spot setting function, when a destination spot is set concretely, plural types of destination attribute names (for example, attribute names representing types of destination spots such as a golf course, a theme park and a restaurant. The hierarchy of the destination candidates composed of the attribute names is the first hierarchy) are first displayed, and the user selects a target attribute of the destination spot from those plural attribute names. Then, plural names of prefectures (the hierarchy of the destination candidates composed of prefecture names is the second hierarchy) in which facilities including the target destination spot exist are displayed. When a name of the target prefecture where the destination spot exists is selected, plural names of areas in the target prefectures (for example, the names of areas such as northern part and southern part. The hierarchy of the spot candidates including the area names is the third hierarchy) are displayed so that a name of a target area where the destination spot exists is selected from the plural area names. Next, plural names of cities/towns/villages existing in the target area (the hierarchy of the spot candidates including the names of cities/towns/villages is the fourth hierarchy) are displayed, and a name of the target city/town/village where the destination spot exists is selected. Then, finally, plural names of concrete facilities having the target attribute selected previously in the selected city/town/village are displayed as destination candidates, and the destination spot is selected from those displayed names of the facilities and set.

[0010] However, in the case where the above-described destination spot setting function of the vehicle navigation device is used, a driver needs to change the displayed prefecture names until a desired prefecture name is displayed in order to select the prefecture name included in the second hierarchy, for example. Therefore, there arose a problem that unnecessary time is required for searching the target prefecture name.

[0011] As for this problem, in the vehicle navigation device capable of inputting information by using a voice recognizing function which is being put into practical use recently, all candidate names of prefectures should be vocally reproduced by the device until a desired prefecture name comes out. As a result, the required time becomes unnecessarily long and the driving is hindered because many unnecessary voices are heard.

[0012] Further, according to the above-mentioned destination spot setting function, it is always necessary

to start selecting candidates from the first hierarchy then down to the deeper hierarchies. In this case, for example, even if a user already knows a name of city/town/village where the destination spot exists (belonging to the fourth hierarchy), the driver should unnecessarily start the selecting operation from the uppermost hierarchy, and hence unnecessary operation should be made.

#### SUMMARY OF THE INVENTION

**[0013]** In view of the above, an object of the present invention is to provide an information retrieving apparatus and an information retrieving method, which are capable of retrieving a desired destination spot information quickly, accurately and conveniently in a navigation device having a destination spot setting function using spot candidates data of hierarchical structure.

**[0014]** According to one aspect of the present invention, there is provided an information retrieving apparatus for retrieving target information from plural pieces of candidate information, including: a storage unit for storing the plural pieces of the candidate information in a hierarchical structure including  $m$  hierarchies ( $m$  is a natural number not less than 2); an input unit for inputting information; a judging unit for judging a correspondence of the inputted information with one of the plural pieces of the candidate information and for judging the hierarchy of the candidate information if the correspondence is obtained; and a retrieving unit for retrieving one of the plural pieces of the candidate information as a target information based on a judged result of the judging unit.

**[0015]** In accordance with the apparatus thus configured, the storage unit stores the plural pieces of the candidate information in a hierarchical structure including  $m$  hierarchies. A user can input information via the input unit. Then, the judging unit judges a correspondence of the inputted information with one of the plural pieces of the candidate information, and then judges the hierarchy of the candidate information if the correspondence is obtained. Thereafter, the retrieving unit retrieves one of the plural pieces of the candidate information as a target information based on a judged result of the judging unit.

**[0016]** Therefore, since a hierarchy of inputted candidate information is judged first and then the information is retrieved based on the judged result, it is possible to retrieve target information in the order of hierarchies, or alternatively possible to retrieve target information while skipping one or plural hierarchies and jumping from a hierarchy to a hierarchy. Consequently, a desired target information can be retrieved conveniently in the information retrieval apparatus.

**[0017]** The hierarchical structure may be arranged such that each piece of the candidate information belonging to  $(n+1)$ -th hierarchy ( $n$  is a natural number and  $n < m-1$ ) is associated with one of the plural pieces of the candidate information belonging to  $n$ -th hierarchy.

With this arrangement, if candidate information in the upper hierarchy are different, candidate information in the lower hierarchy corresponding to the candidate information in the upper information are different. Therefore, the hierarchical structure can be constituted to include plural types of candidate information.

**[0018]** It is preferred that the information retrieving apparatus further includes an output unit for outputting input request information which requests a user to input an input information corresponding to the candidate information belonging to one hierarchy of the hierarchical structures, wherein the output unit includes: a unit for outputting the input request information requesting the input of the candidate information belonging to the  $(p+1)$ -th hierarchy if the candidate information belonging to the  $p$ -th hierarchy is inputted in response to the input request information requesting the input of the candidate information belonging to the  $p$ -th hierarchy ( $p$  is a natural number and  $p < m-1$ ); and a unit for outputting the input request information requesting the input of the candidate information belonging to the  $(p+q+1)$ -th hierarchy if the candidate information belonging to the  $(p+q)$ -th hierarchy is inputted in response to the input request information requesting the input of the candidate information belonging to the  $p$ -th hierarchy ( $q$  is a natural number and  $(p+q) < m-1$ ). This enables the retrieval in the order of the hierarchical structure or alternatively enables the retrieval with jumping between the hierarchies.

**[0019]** In addition, the output unit may further include a unit for outputting the input request information requesting the input of the candidate information in  $r$ -th hierarchy ( $r$  is a natural number and  $r < m-1$ ) if no candidate information is inputted for a predetermined time in response to input request information requesting the input of the candidate information belonging to the  $r$ -th hierarchy. With this arrangement, if no input in response to the input request information of a hierarchy is made, another input request information of the lower hierarchy is outputted, thereby accelerating the retrieval of the target information.

**[0020]** It a preferred embodiment, the candidate information may include a plurality of candidate information groups each including the plural pieces of the candidate information in one hierarchy, wherein the candidate information included in one candidate information group is different from the candidate information included in another candidate information groups, and wherein, if no input information corresponding to the candidate information is inputted for a predetermined time in response to input request information requesting the input of the candidate information included in one candidate information group, the output unit outputs the input request information requesting the input of the candidate information included in a candidate information group other than the one candidate information group.

**[0021]** With this arrangement, an output of one input request information can be rapidly made. In addition,

the desired candidate information can be inputted without the need to output all candidate information in one hierarchy.

[0022] The output unit may output the input request information in a form of voice, wherein the information inputted through the input unit is voice information, and wherein the input unit includes a voice recognition unit for recognizing a content of the inputted voice information. This achieves safer and more convenient input of information.

[0023] According to another aspect of the present invention, there is provided an information retrieving apparatus for retrieving target information from plural pieces of candidate information, including: a storage unit for storing the plural pieces of the candidate information in a hierarchical structure including a plurality of hierarchies; an input unit for inputting information; a determining unit for determining the candidate information corresponding to the inputted information; and a retrieving unit for retrieving one of the plural pieces of candidate information which belong to the lower hierarchy of the determined candidate information and are associated with the determined candidate information. Consequently, a desired target information can be retrieved conveniently in the information retrieval apparatus.

[0024] According to still another aspect of the present invention, there is provided a method of retrieving target information from plural pieces of candidate information composing a hierarchical structure including  $m$  hierarchies ( $m$  is a natural number not less than 2), wherein the hierarchical structure is arranged such that each piece of the candidate information belonging to  $(n+1)$ -th hierarchy ( $n$  is a natural number and  $n < m-1$ ) is associated with one of the plural pieces of the candidate information included in  $n$ -th hierarchy, the method including the steps of: receiving voice information; judging a correspondence of inputted voice information with one of the plural pieces of the candidate information and judging the hierarchy of the candidate information if the correspondence is obtained; and retrieving one of the plural pieces of the candidate information as a target information based on a judged result of the judging step.

[0025] In accordance with the apparatus thus configured, the plural pieces of the candidate information are stored in a hierarchical structure including  $m$  hierarchies. An input information is received, and then a correspondence of the inputted information with one of the plural pieces of the candidate information is judged. Then, the hierarchy of the candidate information is judged if the correspondence is obtained. Thereafter, one of the plural pieces of the candidate information is retrieved as a target information based on a judgement result.

[0026] Therefore, it is possible to retrieve target information in the order of hierarchies, or to retrieve target information while skipping one or plural hierarchies and jumping from a hierarchy to a hierarchy.

[0027] The nature, utility, and further features of this invention will be more clearly apparent from the following detailed description with respect to preferred embodiment of the invention when read in conjunction with the accompanying drawings briefly described below.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

FIG. 1 is a schematic block diagram showing the configuration of the vehicle navigation apparatus according to the present invention.

FIGS. 2A and 2B are schematic diagrams showing the hierarchical structure of request messages and recognition words, respectively.

FIG. 3 is a flowchart showing a main routine of information retrieving process according to an embodiment of the present invention.

FIG. 4 is a flowchart showing a hierarchy judgement routine in the information retrieving process of the invention.

FIG. 5 is a flowchart showing a following part of the routine shown in FIG. 4.

FIG. 6 is a flowchart showing a following part of the routine shown in FIG. 5.

FIGS. 7A and 7B are flowcharts showing hierarchy determination routine in the information retrieving process of the invention.

FIG. 8 is another flowchart showing a following part of the routine shown in FIG. 5.

FIG. 9 is still another flowchart showing a following part of the routine shown in FIG. 5.

FIGS. 10A and 10B are flowcharts showing hierarchy determination routine in the information retrieving process of the invention.

FIG. 11 is still another flowchart showing a following part of the routine shown in FIG. 5.

FIG. 12 is still another flowchart showing a following part of the routine shown in FIG. 5.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0029] The preferred embodiment of the present invention will be described below. It is noted that the embodiment described below is directed to the case where the present invention is applied to a vehicle navigation device which has a voice recognition function and a voice synthesizing function and is capable of inputting/outputting information as voice.

[0030] At first, the configuration of the vehicle navigation device according to the present embodiment will be described below with reference to FIG. 1.

[0031] As shown in FIG. 1, a vehicle navigation device S is provided with an angular velocity sensor 1, a travel distance sensor 2, a GPS receiver 3, a system control-

ler 4, an input unit 10 such as a remote control unit, a DVD-ROM drive 11, a display unit 12, an audio reproduction unit 17, a voice recognition decoder 21, a voice synthesizing unit 22 and a speaker 23. The angular velocity sensor 1 detects an angular velocity of rotation of an vehicle so as to output angular velocity data and relative orientation data. The travel distance sensor 2 calculates a pulse number per rotation of wheels by counting a pulse number in a pulse signal of a predetermined period outputted according to rotation of the wheels so as to output travel distance data based on the pulse number per rotation. The GPS receiver 3 receives radio waves from GPS satellites so as to output GPS position measuring data and absolute orientation data indicating the advancing direction of the vehicle. The system controller 4 controls the whole navigation device based on the relative orientation data, the angular velocity data, the travel distance data, the GPS position measuring data and the absolute orientation data. The input unit 10 is used by a user or driver to input various data. The DVD-ROM drive 11 reads out and outputs various data such as map data including road data representing a number of traffic lanes, road widths and the like and data representing names of facilities and detailed information from a DVD-ROM (DVD-Read Only Memory) disk DK under the control by the system controller 4. The display unit 12 displays the various display data under the control by the system controller 4. The audio reproduction unit 17 reproduces and outputs various voice data under the control by the system controller 4. The voice recognition decoder 21 recognizes contents of voices inputted from an external microphone 200. The voice synthesizing unit 22 synthesizes voices based on the voice data outputted from the voice recognition decoder 21. The speaker 23 outputs a synthesized voice signal outputted from the voice synthesizing unit 22 to be audible to the user or driver.

**[0032]** The system controller 4 includes an interface unit 5, a CPU 6 as a computer, a ROM (Read Only Memory) 7 and a RAM 8. The interface unit 5 performs an interface operation with the external sensors such as the GPS receiver 3. The CPU 6 controls the whole system controller 4. The ROM 7 stores a basic control program and the like for controlling the CPU 6. The RAM 8 has a non-volatile memory, not shown, and stores various data, such as route data which has been set in advance by a user via the input unit 10 and data necessary for the processing in the CPU 6 in rewritable manner. The system controller 4 is connected with the input unit 10, the DVD-ROM drive 11, the display unit 12, the audio reproduction unit 17 and the voice recognition decoder 21 via a bus line 9. The control program for the information retrieving process, described later, executed by the CPU 6 is recorded beforehand in the DVD-ROM disk DK and is read out by the DVD-ROM drive 11 when it becomes necessary.

**[0033]** The display unit 12 includes a graphic controller 13, a buffer memory 14, a display control unit 15 and

a display 16. The graphic controller 13 controls the whole display unit 12 based on the control data transmitted from the CPU 6 via the bus line 9. The buffer memory 14 may be composed of a memory such as a VRAM (Video RAM), and temporarily stores image information which can be displayed immediately. The display control unit 15 controls the display 16 composed of a liquid crystal display device, a CRT (Cathode Ray Tube) display device or the like based on image data outputted from the graphic controller 13.

**[0034]** The audio reproduction unit 17 includes a D/A converter 18, an amplifier 19 and a speaker 20. The D/A converter 18 converts digital voice data transmitted from the DVD-ROM drive 11 or the RAM 8 via the bus line 9 into analog voice signal. The amplifier 19 amplifies the analog voice signal outputted from the D/A converter 18. The speaker 20 converts the amplified analog voice signal into a voice so as to be outputted as an audible voice message from the navigation device.

**[0035]** The voice recognition decoder 21 has a voice recognition circuit for recognizing human voice. When a spoken word is inputted via the external microphone 200, a candidate word which is closest to the spoken word is selected from an internal dictionary including information representing many words, and candidate word data representing the selected candidate word are outputted to the CPU 6 via the bus line 9. Here, the internal dictionary may be stored in the DVD-ROM disk DK and read out by the DVD-ROM drive 11 according to needs.

**[0036]** In the vehicle navigation device S having the above-mentioned configuration, when a user inputs spot information or the like representing a destination spot via the external microphone 200 in the course of the processing procedure described later, the candidate word corresponding to the inputted word is retrieved by the voice recognition decoder 21, and map data or the like stored in the DVD-ROM disk DK are read out by the system controller 4 based on the retrieved candidate word so as to be displayed on the display unit 12.

**[0037]** Of course, a destination spot or the like may be inputted by the input unit 10. Alternatively, however, such information may be inputted easily by voice input to dispense with an operation by buttons or the like on the input unit 10.

**[0038]** In addition, in the vehicle navigation device S shown in FIG. 1, plural kinds of place names or facility names which are frequently set as a destination spot may be selected and registered, in advance, in the RAM 8 together with a number of times at which they are selected and adopted as the destination spot.

**[0039]** In addition, a plurality of place names or facility names which have been retrieved recently and set as a destination spot may be stored in the RAM 8.

**[0040]** Next, with reference to FIGS. 2A and 2B, the description will be given of the data structures of request message data used for voice output from the speaker 23 and recognition words used for recognizing

a voice inputted via the external microphone 200 (namely, a voice recognizing data corresponding to words to be inputted).

[0041] First, the description will be given of the data structure of the request message data with reference to FIG. 2A. Here, a voice to be outputted from the speaker 23 in the present embodiment is a request message for requesting the user to input information by notifying the user of the content of the information to be inputted next, and 2A shows the data structure of the request messages. The voice data to be outputted as the request message shown in FIG. 2A are recorded beforehand in the DVD-ROM disk DK, and they are read out by the DVD-ROM drive 11 according to need. The method of using respective messages will be described later by referring to flowcharts.

[0042] As shown in FIG. 2A, the request message SM of the present embodiment is classified into six hierarchies.

[0043] Voice data, which are used for outputting a message "where are you going?" just after the power-on of the vehicle navigation device S (more specifically, when an ignition switch of the vehicle is turned on), are stored in an area 50 in a zeroth hierarchy 30 which is the most significant hierarchy.

[0044] Next, voice data for outputting a message "One of prefecture, area code, registered address, genre and recently retrieved address, please.", which should be outputted via the speaker 23 after the request message SM "Where are you going?", are stored in an area 51 of a first hierarchy 31.

[0045] Next, voice data for outputting a message "Prefecture, please.", which is associated with the word "prefecture" of the message in the area 51, are stored in an area 52 in a second hierarchy 32.

[0046] Next, voice data for outputting a message "City name, please.", which is associated with the message in the area 52, are stored in an area 53 in a third hierarchy 33.

[0047] In addition, voice data for outputting a message "Address, please.", which is associated with the message in the area 53, are stored in an area 54 in a fourth hierarchy 34.

[0048] Next, voice data for outputting a message "Area code, please.", which is associated with the word "area code" of the message in the area 51, are stored in an area 55 in the second hierarchy 32.

[0049] In addition, voice data for outputting a message "Area code, please.", which is associated with the message in the area 55, are stored in an area 56 in the third hierarchy 33.

[0050] Further, voice data for outputting a message "Remaining part of the phone number, please.", which is associated with the message in the area 56, are stored in an area 57 in the fourth hierarchy 34.

[0051] Next, voice data for outputting a message "Address, please.", which is associated with the word "registered address" and the word "recently retrieved

address" in the message in the area 51, are stored in an area 58 in the second hierarchy 32.

[0052] In addition, voice data for outputting a message "○○, XX, △△, ◆◆, ◎◎, or the others?" as a message of the first segment, which is associated with the message in the area 58, are stored in an area 59 in the third hierarchy 33.

[0053] Further, voice data for outputting a message "●●, ▲▲, ▽▽, □□, or ◇◇?" as a message of the second segment, which is associated with the message in the area 58, are stored in an area 60 in the third hierarchy 33.

[0054] Here, the above-mentioned "○○", "XX", "△△", "◆◆", "◎◎", "●●", "▲▲", "▽▽", "□□" and "◇◇" represent concrete registered addresses which are used frequently or concrete addresses which are different from each other and have been retrieved recently.

[0055] Next, voice data for outputting a message "Station, highway, amusement park, golf course, ski area or the others?" as a message of the first segment, which is associated with the word "genre" in the message in the area 51, are stored in an area 61 in the second hierarchy 32.

[0056] In addition, voice data for outputting a message "accommodation facility, hospital, educational facility, park, campsite or the others?" as a message of the second segment, which is associated with the word "genre", are stored in an area 62 in the second hierarchy 32.

[0057] Further, voice data for outputting a message "Resort facility, public office, ferry terminal or airport?" as a message of the third segment, which is associated with the word "genre", are stored in an area 63 in the second hierarchy 32.

[0058] Next, information suggesting the access to the area 52 in order to output the message ("Prefecture, please.") in the area 52 according to the message in the area 61, 62 or 63, are stored in an area 64 in the third hierarchy 33.

[0059] Next, information suggesting the access to the area 53 in order to output the message ("City name, please.") in the area 53 according to the information in the area 64, are stored in an area 65 in the fourth hierarchy 34.

[0060] Finally, information suggesting the access to the area 54 in order to output the message ("Address, please.") in the area 54 according to the information in the area 65, are stored in an area 66 in the fifth hierarchy 35.

[0061] Here, as is clear from the data structure of the request messages SM, as for the request messages SM in the hierarchies not higher than the second hierarchy 32, one request message SM in the upper hierarchy is associated with one request message SM in the lower hierarchy. Therefore, the request message SM in the lower hierarchy is not associated with plural request messages SM in the upper hierarchies.

[0062] Next, the description will be given of the data

structure of the recognition words W with reference to FIG. 2B. Here, the recognition words in the present embodiment are words used to recognize the voice that a user inputs in response to the request messages SM. FIG. 2B shows a data structure of the recognition words W. The voice data corresponding to the recognition words shown in FIG. 2B are stored beforehand in the DVD-ROM disk DK as the internal dictionary and are read out by the DVD-ROM drive 11 according to need. The method of using the following recognition words will be described later together with flowcharts.

[0063] As shown in FIG. 2B, the recognition words W of the present embodiment are classified into five hierarchies so as to correspond to the respective hierarchies of the above request messages SM.

[0064] A dictionary, which shows the words "prefectures", "area code", "registered addresses", "genre" and "recently retrieved address" in order to recognize a voice inputted in response to the message in the area 51 in the request messages SM, are stored in an area 70 in a first hierarchy 40 which is the most significant hierarchy.

[0065] Next, a dictionary, which shows real names of the prefectures ("Tokyo-To", "Kanagawa-Ken" and the like) associated with the word "prefecture" in the message in the area 70 and used for recognizing a voice inputted in response to the word "Prefecture, please." in the area 52 in the request messages SM, is stored in an area 71 in a second hierarchy 41.

[0066] In addition, a dictionary, which shows real names of the city ("Shinagawa-Ku", "Yokohama-Shi" and the like) associated with the word in the area 71 and used for recognizing a voice inputted in response to the word ("City name, please.") in the area 53 in the request message SM, is stored in an area 72 in a third hierarchy 42.

[0067] Next, a dictionary, which shows concrete addresses associated with the word in the area 72 and used for recognizing a voice inputted in response to the phrase ("Address, please.") in the area 54 in the request message SM, is stored in an area 73 in a fourth hierarchy 43.

[0068] In addition, a dictionary, which shows the area codes ("03", "045" and the like) associated with the word "area codes" in the message in the area 70 and used for recognizing a voice inputted in response to the phrase ("Area code, please.") in the area 55 in the request message SM, is stored in an area 74 in the second hierarchy 41.

[0069] Next, a dictionary, which shows the area codes ("111", "987" and the like) associated with the word in the area 74 and used for recognizing a voice inputted in response to the phrase ("Area code, please.") in the area 56 in the request message SM, is stored in an area 75 in the third hierarchy 42.

[0070] Further, a dictionary, which shows telephone numbers ("2345", "9876" and the like) associated with the word in the area 75 and used for recognizing a voice

inputted in response to the phrase ("Remaining part of the phone number, please.") in the area 57 in the request message SM, is stored in an area 76 in the fourth hierarchy 43.

[0071] In addition, a dictionary, which shows concrete addresses associated with the word "registered addresses" and the word "recently retrieved addresses" in the messages in the area 70 and used for recognizing a voice inputted in response to the phrase ("Address, please.") in the area 58 in the request message SM, is stored in an area 77 in the second hierarchy 41.

[0072] Next, a dictionary, which shows the concrete words "○○", "XX", "△△", "◆◆", "◎◎" and "the others" associated with the word in the area 77 and used for recognizing a voice inputted in response to the phrase ("○○, XX, △△, ◆◆, ◎◎ or the others?") in the area 59 in the request message SM, is stored in an area 78 in the third hierarchy 42.

[0073] In addition, a dictionary, which shows the concrete words "●●", "▲▲", "▽▽", "□□" and "◇◇" associated with the word in the area 77 and used for recognizing a voice inputted in response to the phrase ("●●, ▲▲, ▽▽, □□ or ◇◇?") in the area 60 in the request message SM, is stored in an area 79 in the third hierarchy 42.

[0074] Next, a dictionary, which shows the words "station", "highway facility", "amusement park", "golf course" "ski area" and "the others" associated with the word "genre" in the message in the area 70 and used for recognizing a voice inputted in response to the phrase ("Station, highway facility, amusement park, golf course, ski area or the others?") in the area 61 in the request message SM, is stored in the area 79 in the second hierarchy 41.

[0075] In addition, a dictionary, which shows the words "accommodation facility", "hospital", "educational facility", "park", "campsite" and "the others" associated with the word "genre" in the message in the area 70 and used for recognizing a voice inputted in response to the phrase ("Accommodation facility, hospital, educational facility, park, campsite or the others?") in the area 62 in the request message SM, is stored in an area 80 in the second hierarchy 41.

[0076] Further, information suggesting the access to the area 71 associated with the word in the area 79, 80 or 81 and used to wait for voice input using the words in the area 71 (real names of the prefectures) in response to the information in the area 64 in the request message SM is stored in an area 82 in the third hierarchy 42.

[0077] Next, information suggesting the access to the area 72 associated with the word in the area 82 and used to wait for voice input by using the words (real names of the prefectures) in the area 72 in response to the information in the area 65 in the request message SM is stored in an area 83 in the fourth hierarchy 43.

[0078] Next, information suggesting the access to the area 73 associated with the word in the area 83 and used to wait for voice input by using the words (real addresses) in the area 73 in response to the information



in the area 66 in the request message SM is stored in an area 84 in the fifth hierarchy 44.

[0079] Here, as is clear from the data structure of the recognition words W, as for the recognition words W in the hierarchies not higher than the second hierarchy 41, one recognition word in the upper hierarchy is associated with one recognition word W in the lower hierarchy. Therefore, the recognition word W in the lower hierarchy is not associated with plural recognition words W in the upper hierarchy. Therefore, it is not necessary to wait for voice input using all the recognition words W, and thus it may be enough to wait for voice input using the words in the lower hierarchies associated with the selected words in the upper hierarchies.

[0080] Here, even if a voice "Shinagawa-Ku", for example, is inputted in response to the message "Prefecture, please." in the request message SM, it is preferred to recognize this voice input. In order to achieve this, when waiting for voice input after the request message SM in the first hierarchy 31 is outputted, not only the recognition word W in the first hierarchy 40 corresponding to the outputted request message SM but also the respective recognition words in the second, third, fourth and fifth hierarchies 41, 42, 43 and 44 associated with the recognition word W in the first hierarchy 40 may be referred to.

[0081] Similarly to this, when waiting for voice input after the request message SM in the second hierarchy 32 associated with the request message SM in the first hierarchy, not only the recognition word W in the second hierarchy 41 corresponding to the outputted request message SM but also the respective recognition words in the third, fourth and fifth hierarchies 42, 43 and 44 associated with the recognition word W in the second hierarchy 41 may be referred to.

[0082] Further, when waiting for voice input after the request message SM in the third hierarchy 33 associated with the request message SM in the second hierarchy 32 selected previously is outputted, not only the recognition word W in the third hierarchy 42 corresponding to the outputted request message SM but also the respective recognition words W in the fourth and fifth hierarchies 43 and 44 associated with and according to the recognition word W in the third hierarchy 42 may be referred to.

[0083] Next, the information retrieval process according to the present invention using the request messages SM and the recognition words W having the data structure shown in FIGS. 2A and 2B will be described with reference to the flowcharts shown in FIGS. 3 through 12. Here, in the respective flowcharts, "first request voice is outputted", for example, means that a voice corresponding to the message in the first hierarchy 31 in the request messages SM is outputted. Moreover, the operations shown in the respective flowcharts are performed by CPU 6 by reading out and executing the control programs stored in the DVD-ROM disk DK.

[0084] As shown in FIG. 3, in the information retrieving

process of the present embodiment, at first, when an ignition key or the like of a vehicle is turned on, a judgment is made as to whether or not the power source of the vehicle navigation device S is turned on (step S1). Then, if the power source is not turned on (step S1; NO), the turning-on of the power source is waited, and if the power source is turned on (step S1; YES), the initial setting including initialization of the RAM 8 and the like is executed (step S2).

[0085] Thereafter, if an information retrieval mode is started by an input operation via the input unit 10 or the like (step S3), the zeroth request voice "Where are you going?" is outputted through the speaker 23 (step S4).

[0086] Next, a judgment is made as to whether or not voice input responding to the zeroth request voice (hereinafter, a voice input in response to respective request voices is simply referred to as "response") is executed (step S5). If a response is made (step S5; YES), a content of the response is recognized by the voice recognition decoder 21 (step S8), and then the hierarchy of the recognition word W corresponding to the content of the response is judged (step S9). The detail of the step S9 will be described later.

[0087] On the other hand, if no response is made for a predetermined time set previously in the judgment at step S5 (step S5; NO), the first request voice "One of prefecture, area code, registered address, recently retrieved address or genre, please." is outputted through the speaker 23 (step S6). A judgment is then made as to whether or not a response is made (step S7). If no response is made for a predetermined time (step S7; NO), it is regarded that the driver does not want to execute the information retrieval process so that the information retrieval process is ended. If a response is made at step S7 (step S7; YES), the sequence goes to step S8 to recognize the content of the response, and goes to step S9.

[0088] Next, the hierarchy judgment at the step S9 will be described in detail with reference to FIG. 4.

[0089] In the hierarchy judging process at the step S9, at first, a judgment is made as to whether or not the response at the step S5 is the word included in the first hierarchy 40 in the recognition words W (step S10). If the response is the word included in the first hierarchy 40 (step S10; YES), the sequence goes to step S20 described later.

[0090] On the contrary, if the response is not the word included in the first hierarchy 40 (step S10; NO) in the judgment at step S10, a judgment is made as to whether or not the response at step S5 is a real name representing a prefecture (for example, "Tokyo", "Kana-gawa" or the like) (step S11).

[0091] If the response is a real name representing the prefecture (step S11; YES), the sequence goes to step S32 described later. If the response is not a real name representing a prefecture (step S11; NO), a judgment is made as to whether or not the response at step S5 is a real name representing a city name (for example, "Shi-

nagawa-Ku", "Yokohama-Shi" or the like) (step S12).

[0092] If the response is a real name representing a city (step S12; YES), the sequence goes to step S73. If the response is not a real name representing a city (step S12; NO), a judgment is made as to whether or not the response at S5 is a real name representing the facilities or places (for example, "Tokyo Dome", "Yokohama Stadium" or the like) (step S13).

[0093] If the response is a real name representing the facilities or places (step S13; YES), in order to display a map where the facility or place exists, a map including the facility or place is retrieved, and map data corresponding to the retrieved map are read out from the DVD-ROM disk DK and displayed (step S17). Then, the process is ended.

[0094] On the other hand, if the response at S5 is neither a facility name nor a place name in the judgment at step S13 (step S13; NO), a judgment is made as to whether or not the response at S5 is a number (numeral) representing an area code of a telephone number (for example, "03", "045" or the like) (step S14).

[0095] If the response is a number representing an area code (step S14; YES), the sequence goes to step S51. If the response is not a number representing an area code (step S14; NO), a judgment is made as to whether or not the response at S5 is a real name representing the destination spot registered previously (for example "China town", "Roppongi" or the like) (step S15).

[0096] If the response is the registered destination spot name (step S15; YES), the sequence goes to step S17 so that a map is retrieved and displayed. If the response is not the registered destination spot name (step S15; NO), a judgment is made as to whether or not the response at S5 is a real name representing the place which has been recently retrieved and stored (step S16).

[0097] If the response is the recently retrieved place (step S16; YES), the sequence goes to step S17 so that a map is retrieved and displayed. If the response is not the retrieved place (step S16; NO), the sequence goes to step S6 so that the aforementioned process is repeated.

[0098] Next, the description will be given of a process executed when the judgement in step S10 results in that the response at step S5 is a content included in the first hierarchy 40, with reference to FIG. 5.

[0099] As shown in FIG. 5, if the response at S5 is a content included in the first hierarchy 40 in the judgment at step S10 (step S10; YES), a judgment is made as to whether or not the response is the word "Prefecture" (step S20). If the response is the word "Prefecture" (step S20; YES), the sequence goes to S25 described later.

[0100] On the other hand, if the response is not the word "Prefecture" (step S20; NO), a judgment is made as to whether or not the response at S5 is the word "Area code" (step S21). If the response is the word

"Area code" (step S21; YES), the sequence goes to step S47 described later.

[0101] If the response is not the word "Area code" (step S21; NO), a judgment is made as to whether or not the response at S5 is the word "Registered address" (step S22). If the response is the word "Registered address" (step S22; YES), the sequence goes to S90 described later.

[0102] If the response is not the word "Registered address" (step S22; NO), a judgment is made as to whether or not the response at S5 is the word "Genre" (step S23). If the response is the word "Genre" (step S23; YES), the sequence goes to step S59 described later.

[0103] If the response is not the word "Genre" (step S23; NO), a judgment is made that the response at S5 is "Recently retrieved place" (step S24), and the sequence goes to step S100 described later.

[0104] Next, the description will be given of a process in the case where the response at step S5 is the word "Prefecture" in the above step S20 with reference to FIG. 6.

[0105] As shown in FIG. 6, if the response at step S5 is the word "Prefecture" in the judgment at step S20 (step S20; YES), a parameter i, which represents a number of times that the request message "Prefecture, please." is outputted, is initialized (step S25), and the second request voice "Prefecture, please." is outputted through the speaker 23 (step S26).

[0106] Then, a judgment is made as to whether or not a response is made (step S27). If no response is made for a predetermined time (step S27; NO), the parameter i is incremented only by one (step S28), and a judgment is made as to whether or not the value of the increased parameter i is "2" (step S29). If the value is "2" (step S29; YES), this means that a response is not made even after the request message "Prefecture, please." is outputted twice. Therefore, a judgment is made that the driver does not want to retrieve information so that the process is ended.

[0107] On the other hand, if the parameter i is not "2" in the judgment at step S29, the sequence returns to step S26 in order to again output the request message "Prefecture, please."

[0108] If a response is made to the request message "Prefecture, please." in the judgment at step S27 (step S27; YES), the response is recognized by the voice recognition decoder 21 (step S30), and the hierarchy of the recognized content is determined (step S31). The detailed process at step S31 will be described later.

[0109] When the hierarchy of the response content recognized at step S30 is determined, the third request voice "City name, please." is outputted through the speaker 23 (step S32).

[0110] Then, a judgment is made as to whether or not a response is made (step S33). If no response is made for a predetermined time (step S33; NO), a map including the city represented by the word is retrieved based

on the word representing the city name in the content recognized at step S30, and map data corresponding to the retrieved map are read out from the DVD-ROM disk DK and displayed (step S34). Then, the process is ended.

[0111] On the other hand, if a response is made to the request message "City name, please." in the judgment at step S33 (step S33; YES), the response is recognized by the voice recognition decoder 21 (step S35), and the hierarchy of the recognized content is determined (step S36). The detailed process at step S36 will also be described later.

[0112] If the hierarchy of the response content recognized at step S35 is determined, the fourth request voice "Address, please." is outputted through the speaker 23 (step S37).

[0113] Then, a judgment is made as to whether or not a response is made (step S38). If no response is made for a predetermined time (step S38; NO), a map including the city represented by the word is retrieved based on the word representing the city in the content recognized at step S35, and map data corresponding to the retrieved map are read out from the DVD-ROM disk DK and displayed (step S39). Then, the process is ended.

[0114] On the other hand, if a response is made to the request message "Address, please." in the judgment at step S38 (step S38; YES), the response is recognized by the voice recognition decoder 21 (step S40), and the sequence goes to step S17 so that the map data are retrieved and displayed based on the recognized content.

[0115] Next, the description will be given of the content of the hierarchy determination process at the steps S31 and S36 with reference to FIGS. 7A and 7B.

[0116] At first, the description will be given as to the content of the hierarchy determination process at step S31 with reference to FIG. 7A. First, a judgment is made as to whether or not the response at step S27 is a real name representing a prefecture (step S42). If the response is a real name representing the prefecture (step S42; YES), the sequence goes to step S32 so that the aforementioned operation is repeated. On the other hand, if the response is not a real name representing a prefecture (step S42; NO), a judgment is made as to whether or not the response at step S27 is a real name representing a city name (step S43). If the response is a real name representing a city name (step S43; YES), the sequence goes to step S37 so that the aforementioned operation is repeated. On the other hand, if the response is not a real name representing a city name (step S43; NO), a judgment is made as to whether or not the response at step S27 is a real name representing a facility name or a place name (step S44). If the response is a real name representing a facility name or a place name (step S44; YES), the sequence goes to step S17 so that map data are retrieved based on the facility name or the place name, and a corresponding map is displayed. If the response is not a real name rep-

resenting a facility name or a place name (step S44; NO), the sequence goes to step S25 so that the aforementioned operation is repeated.

[0117] Next, the description will be given as to the content of the hierarchy determination process at step S36 with reference to FIG. 7B. At first, a judgment is made as to whether or not the response at step S33 is a real name representing a city name (step S45). If the response is a real name representing a city name (step S45; YES), the sequence goes to step S37 so that the aforementioned operation is repeated. If the response is not a real name representing a city name (step S45; NO), a judgment is made as to whether or not the response at step S33 is a real name representing a facility name or a place name (step S46). If the response is a real name representing a facility name or a place name (step S46; YES), the sequence goes to step S17 so that map data are retrieved based on the facility name or the place name, and a corresponding map is displayed. On the other hand, if the response is not a real name representing a facility name or a place name (step S46; NO), the sequence goes to step S25 so that the aforementioned operation is repeated.

[0118] Next, the description will be given of the process executed when it is determined in step S21 that the response at step S5 is the word "Area code", with reference to FIG. 8.

[0119] As shown in FIG. 8, if the response at step S5 is the word "Area code" in the judgment at step S21 (step S21; YES), the first request voice "Area code, please." is outputted through the speaker 23 (step S47).

[0120] Then, a judgment is made as to whether or not a response is made (step S48). If no response is made for a predetermined time (step S48; NO), the sequence again returns to step S47 so that the first request voice "Area code, please." is outputted. If a response is made (step S48; YES), the response is recognized by the voice recognition decoder 21 (step S49), and a judgment is made as to whether or not the recognized content is an area code (step S50).

[0121] If the content is not an area code (step S50; NO), the sequence again returns to step S47 so that the second request voice "Area code, please." is outputted. If the content is an area code (step S50; YES), the third request voice "City telephone number, please." is outputted through the speaker 23 (step S51).

[0122] Then, a judgment is made as to whether or not a response is made (step S52). If no response is made for a predetermined time (step S52; NO), the sequence again returns to step S51 so that the third request voice "City telephone number, please." is outputted. When a response is made (step S52; YES), the response is recognized by the voice recognition decoder 21 (step S53), and a judgment is made as to whether or not the recognized content is a city telephone number (step S54).

[0123] If the content is not a city telephone number (step S54; NO), the sequence again returns to step S51 so that the third request voice "City telephone number,

please." is outputted. If the content is a city telephone number (step S54; YES), the fourth request voice "Remaining part of the phone number, please." is outputted through the speaker 23 (step S55).

[0124] Then a judgment is made as to whether or not a response is made (step S56). If no response is made for a predetermined time (step S56; NO), the sequence again returns to step S55 so that the fourth request voice "Remaining part of the phone number, please." is outputted. If a response is made (step S56; YES), the response is recognized by the voice recognition decoder 21 (step S57), and a judgment is made as to whether or not the recognized content is the remaining part of the number (step S58).

[0125] If the content is not the remaining part of the number (step S58; NO), the sequence again returns to step S55 so that the fourth request voice "Remaining part of the number, please." is outputted. If the content is the remaining part of the number (step S58; YES), the sequence returns to step S17 so that map data are retrieved based on the inputted telephone number (steps S48, S52 and S56) and a corresponding map is displayed.

[0126] Next, the description will be given of the process executed when it is determined at the step S23 that the response at step S5 is the word "genre name", with reference to FIG. 9.

[0127] As shown in FIG. 9, if the response at step S5 is the word "Genre" in the judgment at step S23 (step S23; YES), the first segment of the second request voice corresponding to the genre name "Station, amusement park, freeway, golf course, ski area or the others?" is outputted through the speaker 23 (step S59).

[0128] Then, a judgment is made as to whether or not a response is made (step S60). If no response is made for a predetermined time (step S60; NO), the sequence goes to step S78 described later.

[0129] If a response is made in the judgment at step S60 (step S60; YES), the response is recognized by the voice recognition decoder 21 (step S61), and a judgment is made as to whether or not the recognized content is the word "The others" (step S62). If the content is the word "The others" (step S62; YES), the second segment of the second request voice corresponding to the genre name "Accommodation facility, hospital, educational facility, park, campsite, or the others?" is outputted through the speaker 23 (step S78).

[0130] Then, a judgment is made as to whether or not a response is made (step S79). If no response is made for a predetermined time (step S79; NO), the sequence goes to step S82 described later.

[0131] If a response is made in the judgment at step S79 (step S79; YES), the response is recognized by the voice recognition decoder 21 (step S80), and a judgment is made as to whether or not the recognized content is the word "The others" (step S81). If the content is the word "The others" (step S81; YES), the third segment of the second request voice corresponding to the

genre name "Resort facility, public office, ferry terminal or airport?" is outputted through the speaker 23 (step S82).

[0132] Then, a judgment is made as to whether or not a response is made (step S83). If no response is made for a predetermined time (step S83; NO), the sequence returns to the step S59 so that the aforementioned operation is repeated.

[0133] If a response is made in the judgment at step S83 (step S83; YES), the response is recognized by the voice recognition decoder 21 (step S84), and the sequence goes to step S63.

[0134] If the recognized content is not the word "The others" in the judgment at step S62 or S81 (step S62; NO or S81; NO), the third request voice "Prefecture, please." is outputted through the speaker 23 (step S63).

[0135] Then, a judgment is made as to whether or not a response is made (step S64). If no response is made for a predetermined time (step S64; NO), the sequence goes to step S67. If a response is made (step S64; YES), the response is recognized by the voice recognition decoder 21 (step S65), and the hierarchy of the recognized content is determined (step S66). The detailed process at step S66 will be described later.

[0136] If the hierarchy of the response content recognized at step S66 is determined, the fourth request voice "City name, please." is outputted through the speaker 23 (step S67).

[0137] Then, a judgment is made as to whether or not a response is made (step S68). If a response is made (step S68; YES), the response is recognized by the voice recognition decoder 21 (step S71), and the hierarchy of the recognized content is determined (step S72). The detailed process at step S72 will be described later.

[0138] On the other hand, if a response is not made for a predetermined time in the judgment at step S68 (step S68; NO), a judgment is made as to whether or not that the response is recognized at the step S65 (step S69). If the response is recognized (step S69; YES), a map including the city represented by the word is retrieved based on the recognized word representing the city name, and map data corresponding to the retrieved map are read out from the DVD-ROM disk DK so as to be displayed (step S70). Then, the process is ended.

[0139] On the other hand, if the response is not recognized in the judgment at step S69 or the hierarchy determination is completed at step S72, the fifth request voice "Address or facility name, please." is outputted through the speaker 23 (step S73).

[0140] Then, a judgment is made as to whether or not a response is made (step S74). If no response is made for a predetermined time (step S74; NO), a judgment is made as to whether or not the response is recognized at the step S71 (step S75). If the response is recognized (step S75; YES), a map including the city represented by the word is retrieved based on the recognized word representing the city name, and map data correspond-

ing to the retrieved map are read out from the DVD-ROM disk DK and displayed (step S70). Then, the process is ended.

[0141] On the other hand, if the response is not recognized in the judgment at step S75 (step S75; NO), a judgment is made as to whether or not the response is recognized at the step S65 (step S76). If the response is recognized (step S76; YES), a map including the city represented by the recognized word is retrieved based on the word representing the city name, and map data corresponding to the retrieved map are read out from the DVD-ROM disk DK and displayed (step S70). Then, the process is ended.

[0142] If the response is not recognized in the judgment at step S76 (step S76; NO), the sequence returns to the step S73 so that the aforementioned operation is repeated.

[0143] Further, if a response is made in the judgment at step S74 (step S74; YES), the response is recognized by the voice recognition decoder 21 (step S77), and the sequence returns to step S17 so that map data are retrieved based on the inputted address or facility name and a corresponding map is displayed.

[0144] Next, the content of the hierarchy determination process at the steps S66 and S72 will be described with reference to FIGS. 10A and 10B.

[0145] At first, the description will be given as to the content of the hierarchy determination process at step S66 with reference to FIG. 10A. First, a judgment is made as to whether or not the response at step S64 is a real name representing a city, town or village name (step S85). If the response is a real name representing a city name (step S85; YES), the sequence goes to step S67 so that the aforementioned operation is repeated. On the other hand, if the response is not a real name representing a city name (step S85; NO), a judgment is made as to whether or not the response at step S64 is a real name representing a city name (step S86). If the response is a real name representing a city name (step S86; YES), the sequence goes to step S73 so that the aforementioned operation is repeated. If the response is not a real name representing a city name (step S86; NO), a judgment is made as to whether or not the response at step S64 is a real name representing a facility name or a place name (step S87). If the response is a real name representing a facility name or a place name (step S87; YES), the sequence goes to step S17 so that map data are retrieved based on the facility or place name and a corresponding map is displayed. If the response is not a real name representing the a facility name or a place name (step S87; NO), the sequence goes to step S63 so that the aforementioned operation is repeated.

[0146] Next, the description will be given as to the content of the hierarchy judging process at step S72 with reference to FIG. 10B. At first, a judgment is made as to whether or not the response at step S68 is a real name representing a city name (step S88). If the

response is a real name representing a city name (step S88; YES), the sequence goes to step S73 so that the aforementioned operation is repeated. On the other hand, if the response is not a real name representing a city name (step S88; NO), a judgment is made as to whether or not the response at step S68 is a real name representing a facility name or a place name (step S89). If the response is a real name representing a facility name or a place name (step S89; YES), the sequence goes to step S17 so that map data are retrieved based on the facility or place name and a corresponding map is displayed. If the response is not a real name representing a facility name or a place names (step S89; NO), the sequence goes to step S73 so that the aforementioned operation is repeated.

[0147] Next, the process executed when it is determined at the step S22 that the response at step S5 is a word "Registered address" will be described with reference to FIG. 11.

[0148] As shown in FIG. 11, if the response at step S5 is the word "Registered address" (step S22; YES), the second request voice "Address, please." is outputted through the speaker 23 (step S90).

[0149] Then, a judgment is made as to whether or not a response is made (step S91). If no response is made for a predetermined time (step S91; NO), the sequence goes to step S93 described later. On the other hand, if a response is made (step S91; YES), the response is recognized by the voice recognition decoder 21 (step S92), and the hierarchy determination process similar to step S31 is executed.

[0150] On the other hand, if no response is made for a predetermined time in the judgment at step S91 (step S91; NO), the first segment of the third request voice corresponding to the registered address "○○, XX, △△, ◆◆, ◎◎ or the others?" is outputted through the speaker 23 (step S93).

[0151] Then, a judgment is made as to whether or not a response is made (step S94). If no response is made for a predetermined time (step S94; NO), the sequence goes to step S97 described later.

[0152] If a response is made in the judgment at step S94 (step S94; YES), the response is recognized by the voice recognition decoder 21 (step S95), and a judgment is made as to whether or not the recognized content is the word "The others" (step S96). If the content is not the word "The others" (step S96; NO), the sequence goes to step S31. If the content is the word "The others" (step S96; YES), the second segment of the third request voice corresponding to the registered address "●●, ▲▲, ▼▼, □□ or ◇◇?" is outputted through the speaker 23 (step S97).

[0153] Then, a judgment is made as to whether or not a response is made (step S98). If no response is made for a predetermined time (step S98; NO), the sequence returns to the step S90 so that the aforementioned operation is repeated.

[0154] If a response is made in the judgment at step

S98 (step S98; YES), the response is recognized by the voice recognition decoder 21 (step S99), and the hierarchy determination at step S31 is executed.

[0155] Next, the process to be executed after the process at the step S24 will be described with reference to FIG. 12.

[0156] As shown in FIG. 12, if a judgment is made at step S24 that the response at step S5 is the word "Recently retrieved address", the second request voice "Address, please." is outputted through the speaker 23 (step S100).

[0157] Then, a judgment is made as to whether or not a response is made (step S101). If no response is made for a predetermined time (step S101; NO), the sequence goes to step S103 described later. On the other hand, if a response is made (step S101; YES), the response is recognized by the voice recognition decoder 21 (step S102), and the hierarchy determination process similar to that at the step S31 is executed.

[0158] If no response is made for a predetermined time in the judgment at step S101 (step S101; NO), the first segment of the third request voice corresponding to the recently retrieved place "○○, XX, △△, ◆◆, ◎◎ or the others?" is outputted through the speaker 23 (step S103).

[0159] Then, a judgment is made as to whether or not a response is made (step S104). If no response is made for a predetermined time (S104; NO), the sequence goes to step S107 described later.

[0160] If a response is made in the judgment at step S104 (step S104; YES), the response is recognized by the voice recognition decoder 21 (step S105), and a judgment is made as to whether or not the recognized content is the word "The others" (step S106). If the content is not the word "The others" (step S106; NO), the sequence goes to step S31. If the content is the word "The others" (step S106; YES), the second segment of the third request voice corresponding to the recently retrieved place "●●, ▲▲, ▼▼, □□ or ◇◇?" is outputted through the speaker 23 (step S107).

[0161] Then, a judgment is made as to whether or not a response is made (step S108). If no response is made for a predetermined time (step S108; NO), the sequence returns to the step S100 so that the aforementioned operation is repeated.

[0162] If a response is made in the judgment at step S108 (step S108; YES), the response is recognized by the voice recognition decoder 21 (step S109), and the aforementioned hierarchy judgment at step S31 is executed.

[0163] As described above, according to the information retrieval process executed in the vehicle navigation device S of the invention, since a hierarchy of inputted voice information is judged and a destination spot is retrieved based on the judged hierarchy, it is possible to retrieve the destination spot in the order of hierarchies, or to retrieve the destination spot while skipping one or plural hierarchies and shifting from a hierarchy to a hier-

archy, for example.

[0164] In addition, the respective recognition words W belonging to the  $n+1$  ( $n$ : natural number in a range of 2 to 4) hierarchy are associated with only one of the recognition words W included in the  $n$  hierarchy. Namely, if the recognition words W in the upper hierarchies are different, the candidate information of recognition words W in the lower hierarchy are different. Therefore, the hierarchical structure can be constituted to include plural types of recognition words W.

[0165] Further, if a judgment is made that the hierarchy of voice information inputted in response to the request message SM in the  $p$ -th hierarchy ( $p$ : natural numbers not more than 5) is the  $p$ -th hierarchy, the request message SM for inputting voice information belonging to the  $(p+1)$ -th hierarchy is outputted through the speaker 23. If a judgment is made that the hierarchy of the voice information inputted in response to the request message SM in the  $p$ -th hierarchy is  $(p+q)$ -th ( $p+q$ : natural numbers not more than 4) hierarchy, the request message SM for inputting voice information belonging to  $(p+q+1)$ -th hierarchy is outputted through the speaker 23. Therefore, a destination spot can be retrieved in the order of the hierarchy structure, or a destination spot can be retrieved while skipping one or plural hierarchies.

[0166] Furthermore, if voice information belonging to a hierarchy represented by an outputted request message SM is not inputted, a request message SM for requesting the input of voice information in one-level lower hierarchy with respect to the former request message SM is outputted. As a result, a desired destination spot can be retrieved quickly.

[0167] In addition, since recognition word W belonging to the third hierarchy 42 corresponding to the registered address or recently retrieved address is divided into plural segments to be outputted, a time required for outputting one request message SM can be shortened. Moreover, desired voice information can be inputted without the need to output a request message SM corresponding to all the recognition words W belonging to one hierarchy.

[0168] Further, since information can be inputted and outputted by a voice, the convenience of the information retrieval process is further improved.

[0169] In addition, in the recognition words W shown in FIG. 2, if one recognition word W in the first hierarchy 40 is selected, for example, voice input is waited for the recognition words belonging to the hierarchies not higher than the second hierarchy 41 by using only the recognition words W associated with the recognition words W in the first hierarchy 40. As a result, a number of the recognition words W for waiting can be reduced, and erroneous recognition of responses can be avoided.

[0170] Further, as for the recognition words W in each hierarchy, their frequency of use may be recorded, and recognition words W, which are used more frequently,

may have priority in use for waiting, or recognition words W, whose content is closer to the contents of recognition words W currently used for waiting, may have priority in use for the recognition of responses. As a result, a number of the recognition words W used in recognizing the responses may be further reduced, and erroneous recognition of responses can be further reduced.

[0171] Here, the above embodiment described the case where the present invention is applied to the vehicle navigation device S, but the present invention can also be applied to an aircraft navigation device and a vessel navigation device.

[0172] An information retrieving apparatus (S) is advantageously used in a voice operation of a vehicle navigation system. The apparatus includes a storage unit (DK, 8) for storing the plural pieces of the candidate information composing a hierarchical structure including m hierarchies (m is a natural number not less than 2), and the apparatus retrieves a target information from the hierarchical structure. The apparatus includes an input unit (200) for inputting information, a judging unit (6) for judging a correspondence of the inputted information with one of the plural pieces of the candidate information and for judging the hierarchy of the candidate information if the correspondence is obtained, and a retrieving unit (6) for retrieving one of the plural pieces of the candidate information as a target information based on a judged result of the judging unit.

#### Claims

1. An information retrieving apparatus (S) for retrieving target information from plural pieces of candidate information, comprising:
  - a storage means (DK, 8) for storing the plural pieces of the candidate information in a hierarchical structure including m hierarchies (m is a natural number not less than 2);
  - an input means (200) for inputting information;
  - a judging means (6) for judging a correspondence of the inputted information with one of the plural pieces of the candidate information and for judging the hierarchy of the candidate information if the correspondence is obtained; and
  - a retrieving (6) means for retrieving one of the plural pieces of the candidate information as a target information based on a judged result of the judging means.
2. An information retrieving apparatus according to claim 1, wherein the hierarchical structure is arranged such that each piece of the candidate information belonging to (n+1)-th hierarchy (n is a natural number and  $n < m-1$ ) is associated with one of the plural pieces of the candidate information belonging to n-th hierarchy.
3. An information retrieving apparatus according to claim 1 or 2, further comprising an output means (22, 23) for outputting input request information which requests a user to input an input information corresponding to the candidate information belonging to one hierarchy of the hierarchical structures, wherein the output means comprises:
  - means for outputting the input request information requesting the input of the candidate information belonging to the (p+1)-th hierarchy if the candidate information belonging to the p-th hierarchy is inputted in response to the input request information requesting the input of the candidate information belonging to the p-th hierarchy (p is a natural number and  $p < m-1$ ); and
  - means for outputting the input request information requesting the input of the candidate information belonging to the (p+q+1)-th hierarchy if the candidate information belonging to the (p+q)-th hierarchy is inputted in response to the input request information requesting the input of the candidate information belonging to the p-th hierarchy (q is a natural number and  $(p+q) < m-1$ ).
4. An information retrieving apparatus according to claim 3, wherein said output means further comprises means for outputting the input request information requesting the input of the candidate information in r-th hierarchy (r is a natural number and  $r < m-1$ ) if no candidate information is inputted for a predetermined time in response to input request information requesting the input of the candidate information belonging to the r-th hierarchy.
5. An information retrieving apparatus according to claim 3 or 4, wherein the candidate information comprises a plurality of candidate information groups each including the plural pieces of the candidate information in one hierarchy, wherein the candidate information included in one candidate information group is different from the candidate information included in another candidate information groups, and wherein, if no input information corresponding to the candidate information is inputted for a predetermined time in response to input request information requesting the input of the candidate information included in one candidate information group, the output means outputs the input request information requesting the input of the candidate information included in a candidate information group other than said one candidate information group.
6. An information retrieval apparatus according to claim 3, 4 or 5, wherein the output means outputs

the input request information in a form of voice, wherein the information inputted through the input means is voice information, and wherein the input means comprises a voice recognition means for recognizing a content of the inputted voice information. 5

7. A method of retrieving target information from plural pieces of candidate information composing a hierarchical structure including  $m$  hierarchies ( $m$  is a natural number not less than 2), wherein the hierarchical structure is arranged such that each piece of the candidate information belonging to  $(n+1)$ -th hierarchy ( $n$  is a natural number and  $n < m-1$ ) is associated with one of the plural pieces of the candidate information included in  $n$ -th hierarchy, the method comprising the steps of: 10 15

receiving voice information;  
judging a correspondence of inputted voice information with one of the plural pieces of the candidate information and for judging the hierarchy of the candidate information if the correspondence is obtained; and  
retrieving one of the plural pieces of the candidate information as a target information based on a judged result of the judging step. 20 25

8. An information retrieving apparatus (S) for retrieving target information from plural pieces of candidate information, comprising: 30

a storage means (DK,8) for storing the plural pieces of the candidate information in a hierarchical structure including a plurality of hierarchies; 35  
an input means (200) for inputting information;  
a determining means (6) for determining the candidate information corresponding to the inputted information; and 40  
a retrieving means (6) for retrieving one of the plural pieces of candidate information which belong to the lower hierarchy of the determined candidate information and are associated with the determined candidate information. 45

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FIG. 1

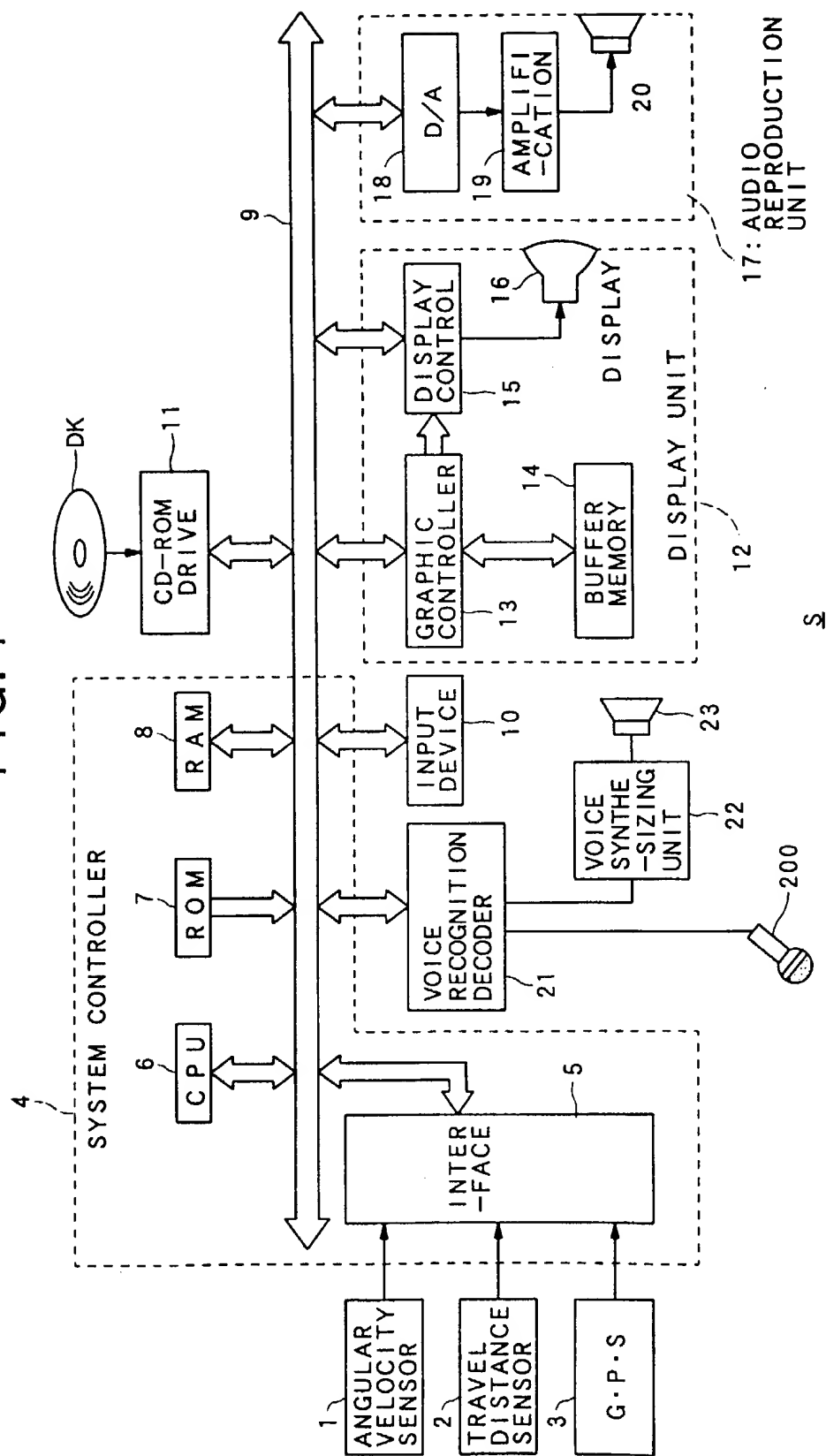


FIG. 2A

SM		REQUEST MESSAGE		
30	ZERO HIERARCHY	"WHERE ARE YOU GOING?"		50
31	FIRST HIERARCHY	ONE OF "PREFECTURE" "AREA CODE" "REGISTERED ADDRESS" "RECENTLY RETRIEVED ADDRESS" "GENRE", PLEASE		51
32	SECOND HIERARCHY	"PREFECTURE, PLEASE"	"AREA CODE, PLEASE"	61
				62
				63
33	THIRD HIERARCHY	"CITY NAME, PLEASE"	"CITY TELEPHONE NUMBER, PLEASE"	64
				65
34	FOURTH HIERARCHY	"ADDRESS, PLEASE"	"REMAINING PART OF THE NUMBER, PLEASE"	66
				67
35	FIFTH HIERARCHY			68



FIG. 3

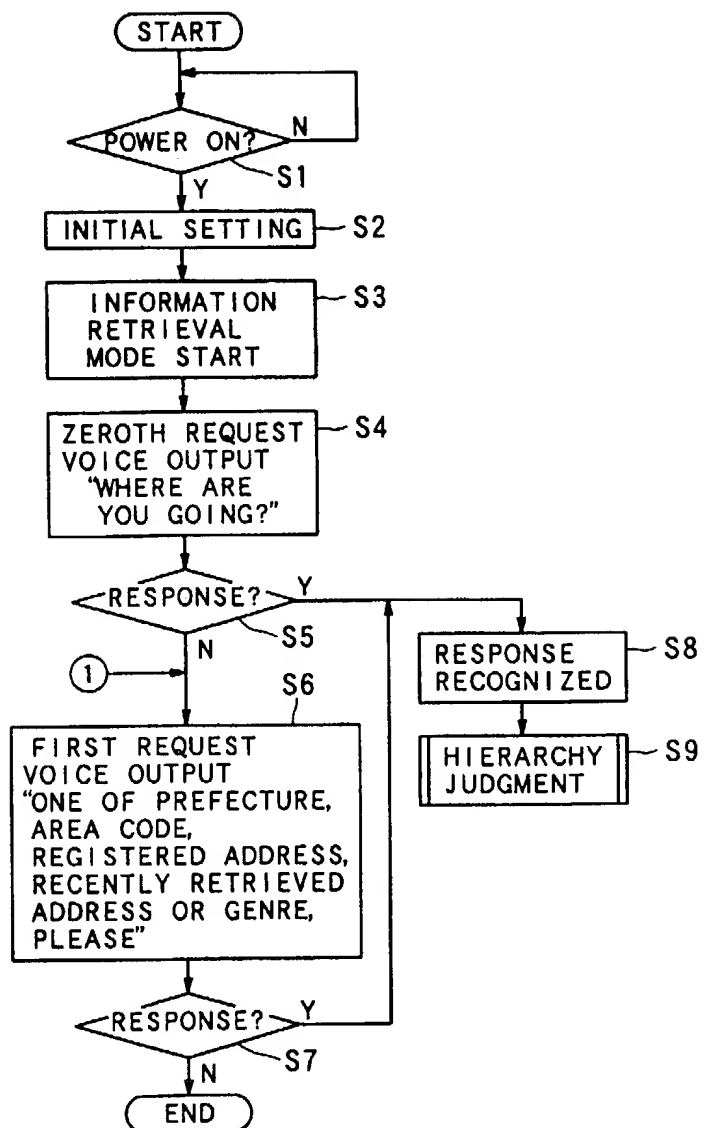


FIG. 4

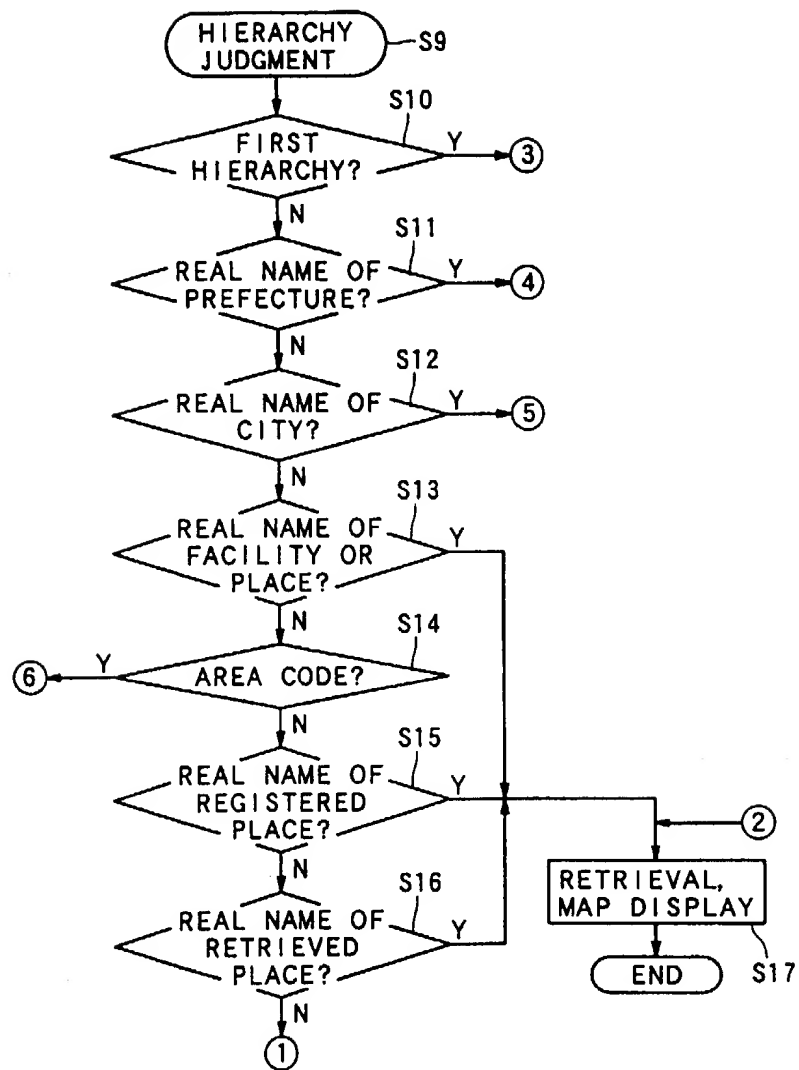


FIG. 5

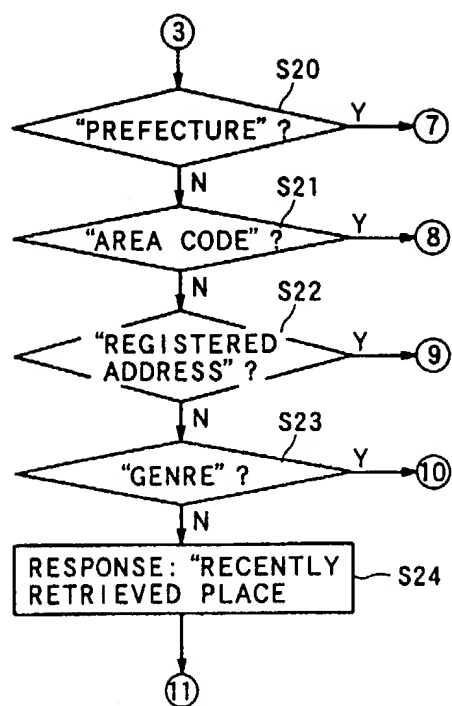


FIG. 6

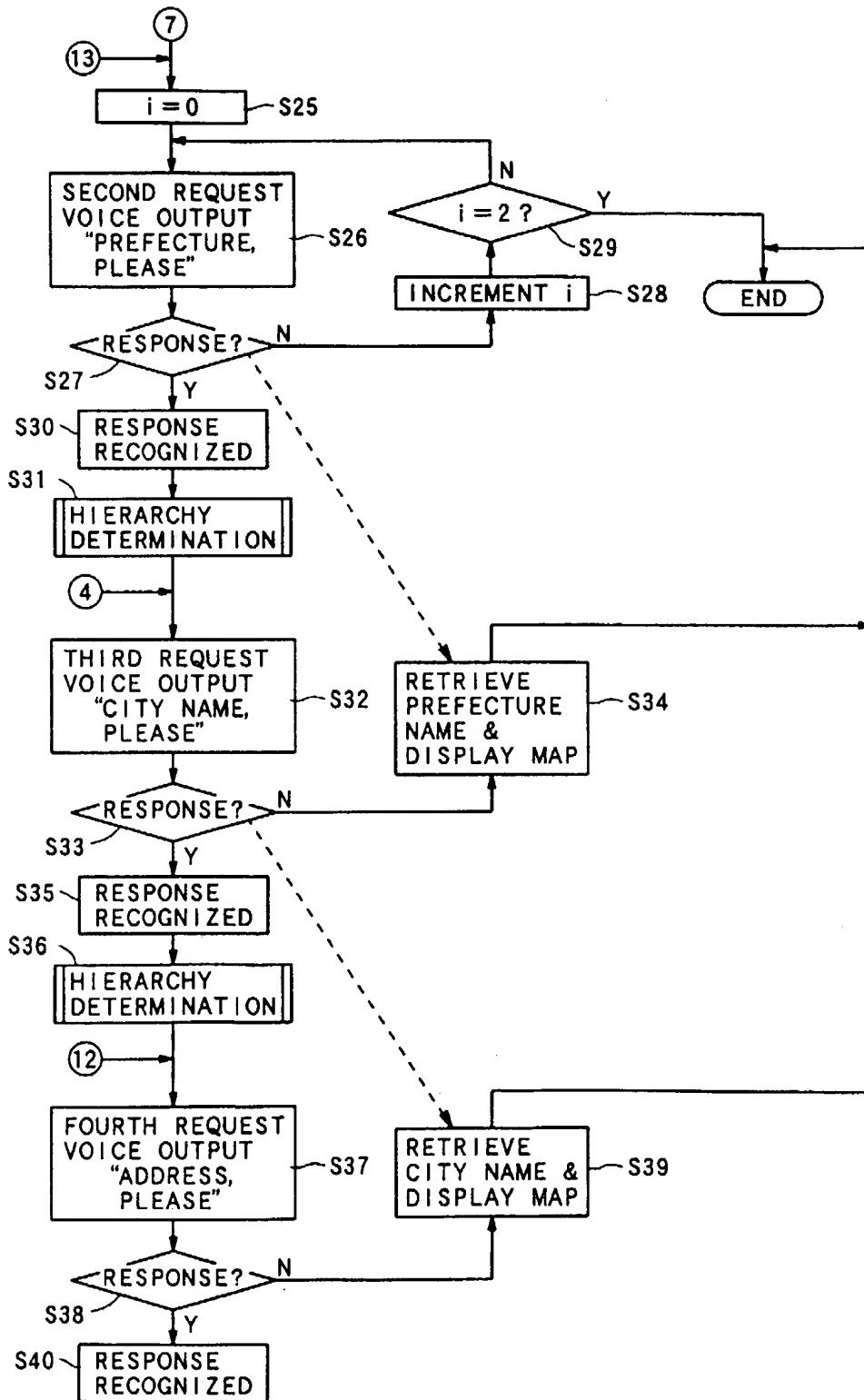


FIG. 7A

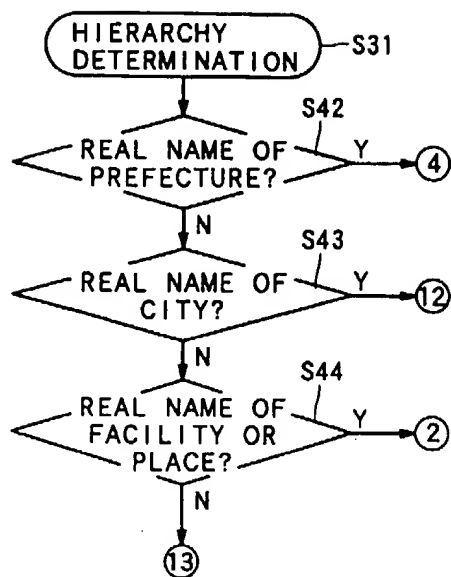


FIG. 7B

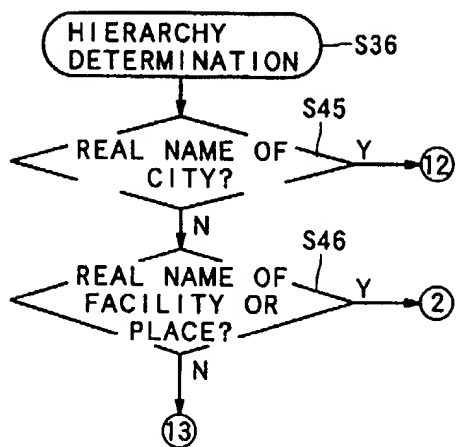




FIG. 8

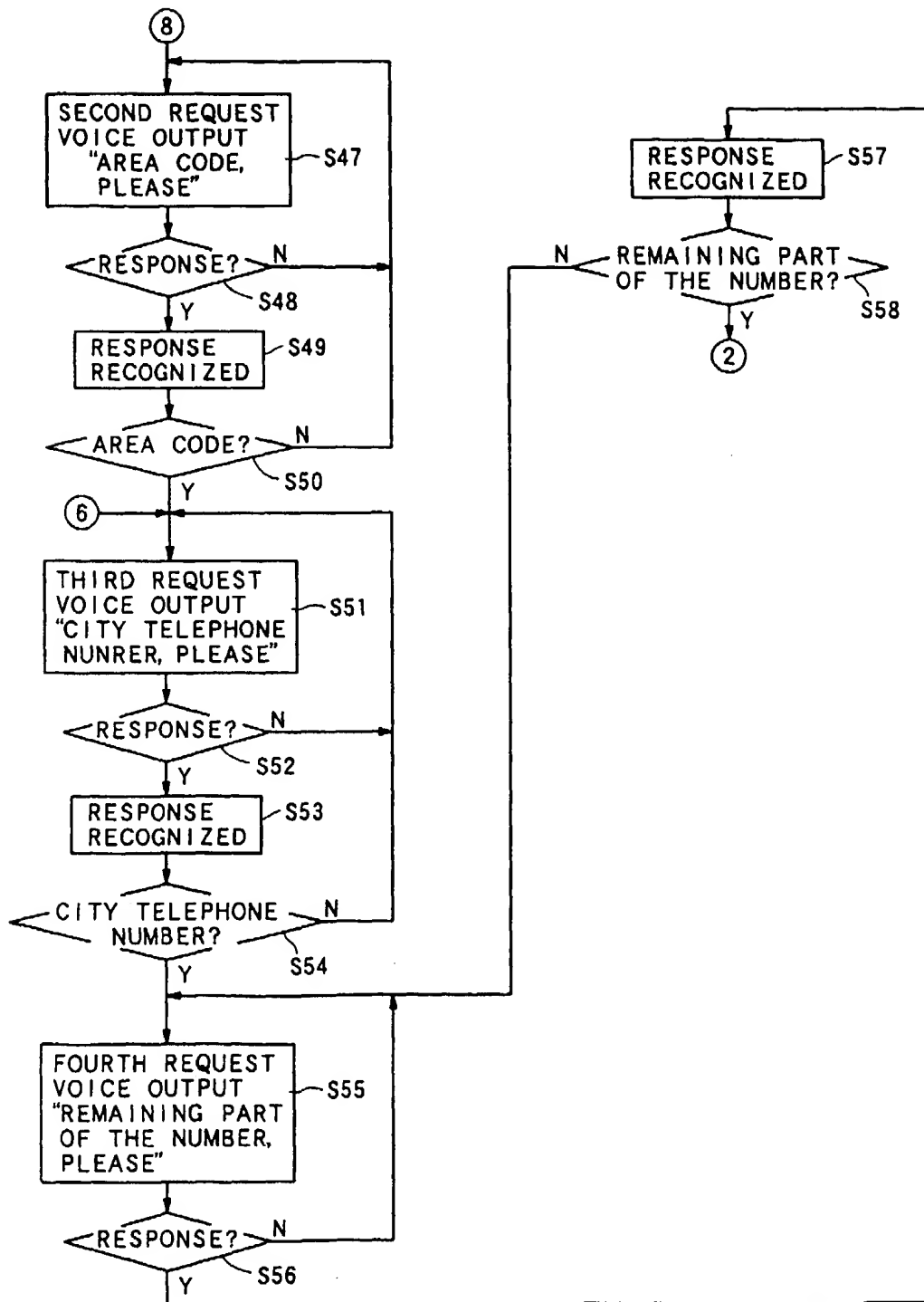


FIG. 9

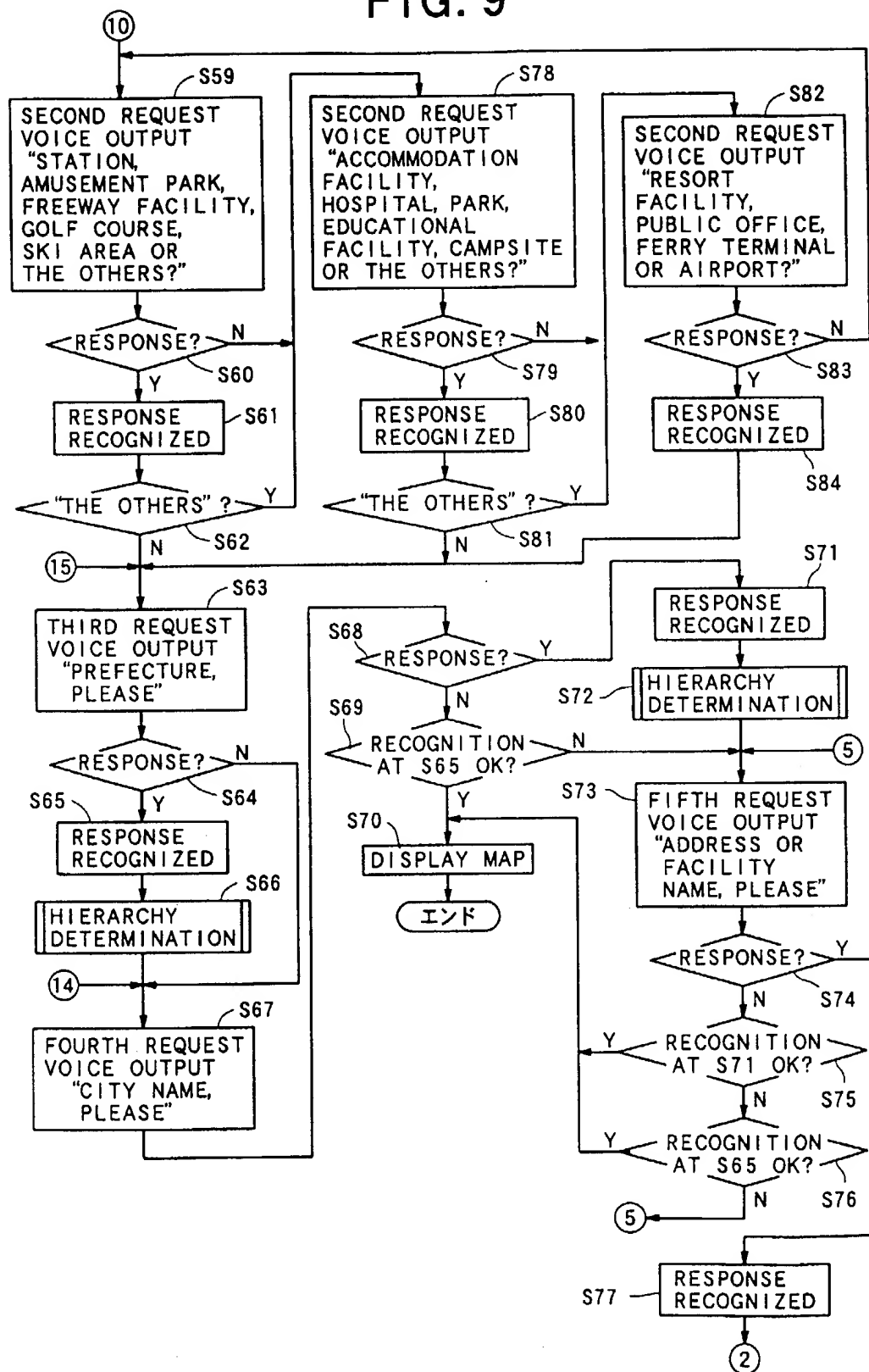


FIG.10A

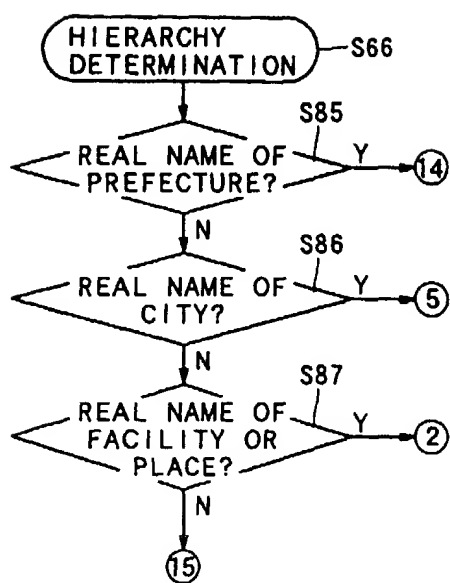


FIG.10B

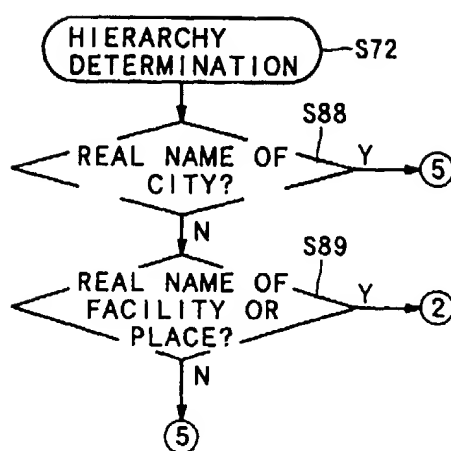


FIG.11

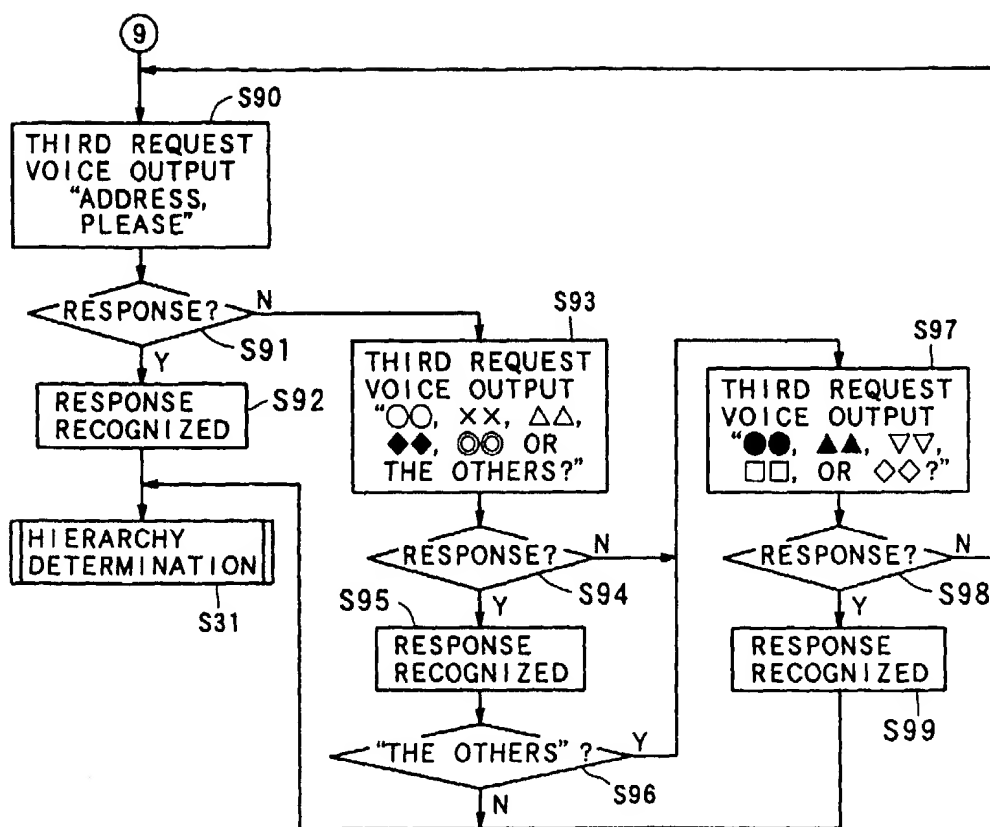
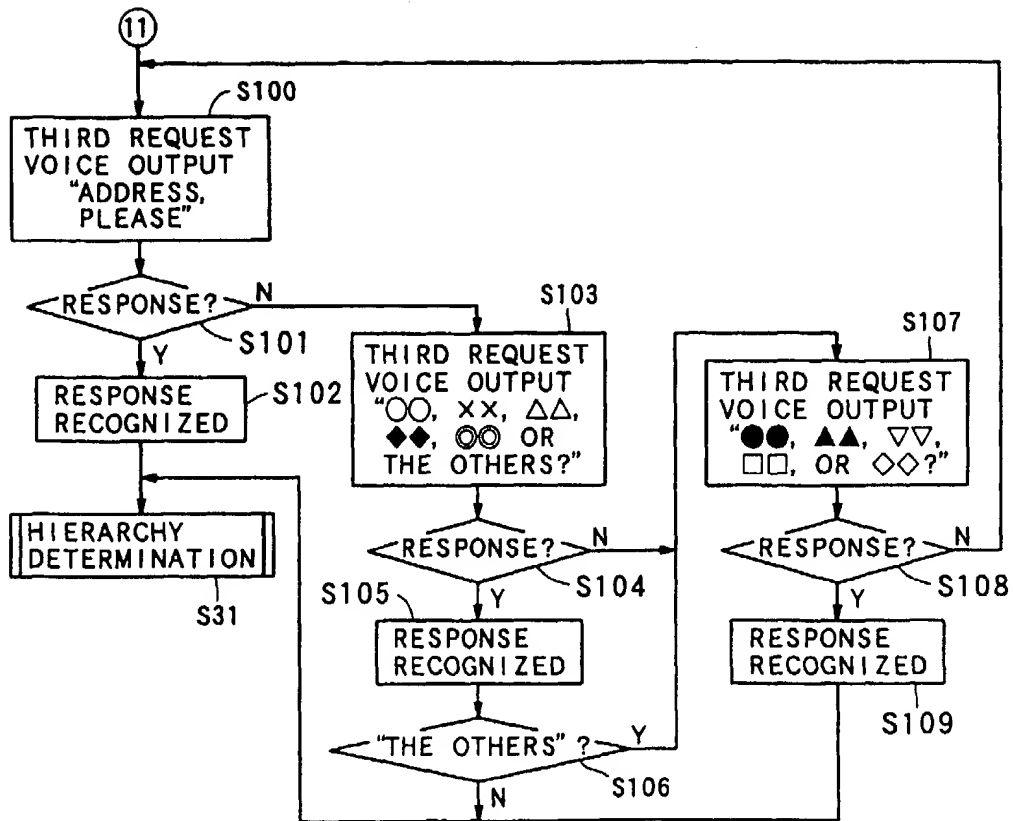


FIG.12





US005337347A

# United States Patent [19]

Halstead-Nussloch et al.

[11] Patent Number: 5,337,347  
[45] Date of Patent: Aug. 9, 1994

[54] METHOD AND SYSTEM FOR  
PROGRESSIVE DATABASE SEARCH  
TERMINATION AND DYNAMIC  
INFORMATION PRESENTATION  
UTILIZING TELEPHONE KEYPAD INPUT

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[21] Appl. No.: 904,415

[22] Filed: Jun. 25, 1992

[51] Int. Cl.<sup>5</sup> ..... H04M 11/08

[52] U.S. Cl. .... 379/67; 379/88;  
379/97

[58] Field of Search ..... 379/67, 88, 89, 97,  
379/213

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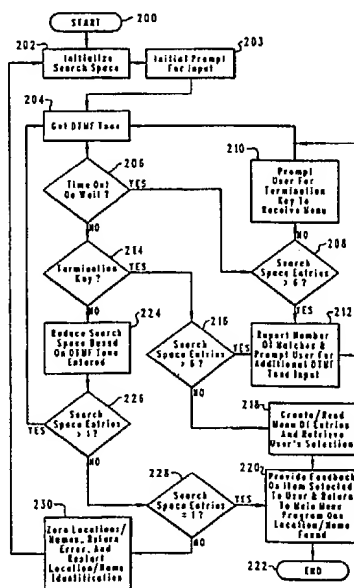
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IBM Technical Disc. Bulletin vol. 23 No. 7B, Dec. 1980, R. L. Rosenfeld "Home (Computer) Terminal Musical Program Selection" pp. 3440-3441.

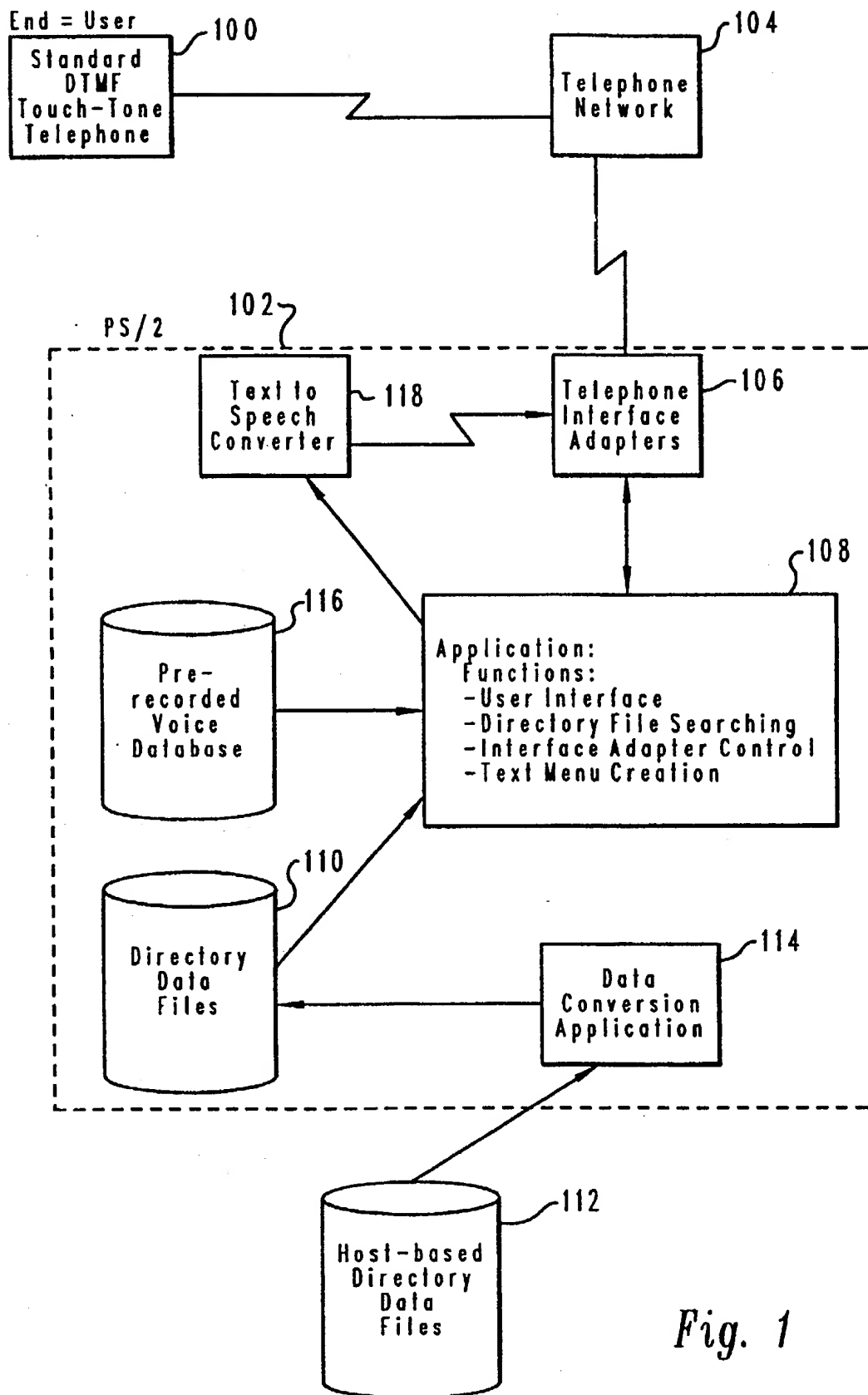
Primary Examiner—James L. Dwyer  
Assistant Examiner—Fan Tsang  
Attorney, Agent, or Firm—J. F. Villella, Jr.; Duke W. Yee; Andrew J. Dillon

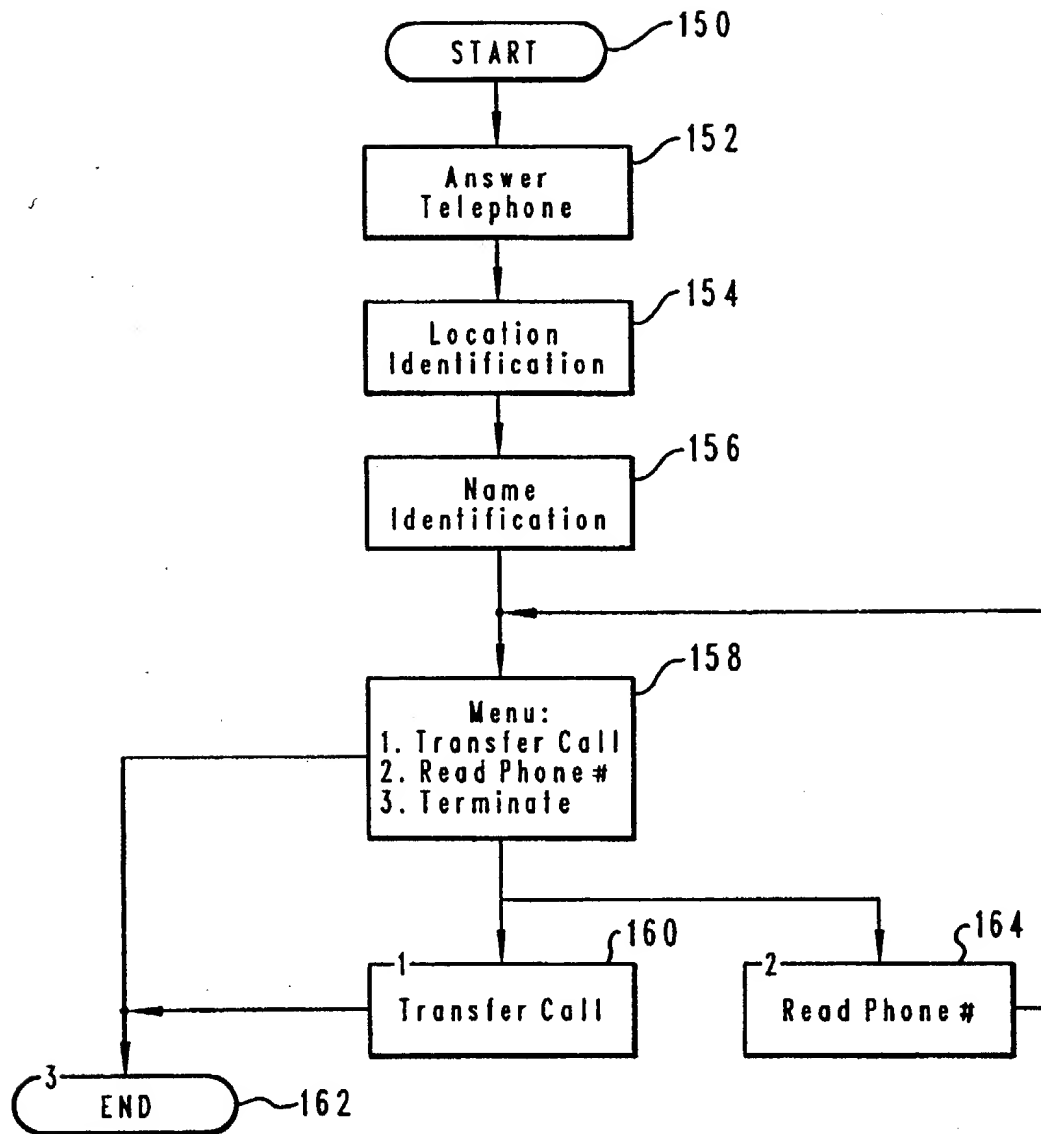
## [57] ABSTRACT

A method and system are disclosed for searching a remote database utilizing a telephone device in communication with a data processing system. The data processing system has access to the remote database and the telephone device includes transmitter components for transmitting dual-tone multifrequency signals, wherein the dual-tone multifrequency signals are generated manipulating a keypad associated with the telephone device. The keypad has individually depressible alpha-numeric keys that may be utilized to generate a query and to send commands to the data processing system. The method of the present invention includes prompting the user to enter a query utilizing the depressible alpha-numeric keys on the keypad. As the query is input from the user, the data processing system searches the database to locate entries within the database corresponding to current state of the query. As the user enters additional data to modify the query, the database is searched for entries corresponding to the each modification of the query entered by the user. The user might or might not be prompted for each modification of the query. These steps of modifying the query and performing a search based on the modified query are repeated until the entries found are less than some predetermined number. At any time, an early termination command generated by the user may be utilized to immediately terminate the steps. In response to the number of entries being less than to the predetermined number or receiving the early termination command, the entries may be presented to the user via the telephone device.

20 Claims, 4 Drawing Sheets



*Fig. 1*

*Fig. 2*



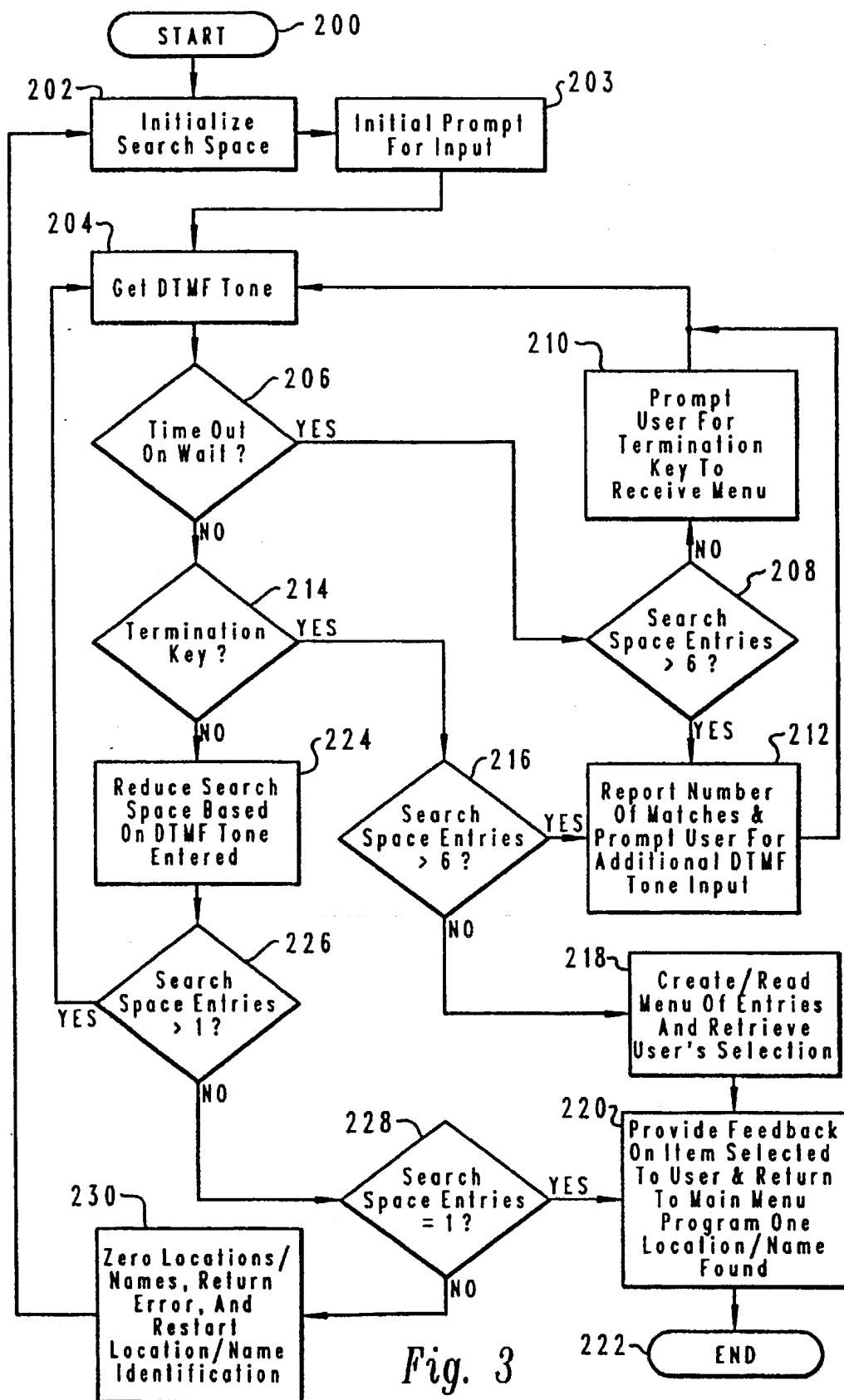
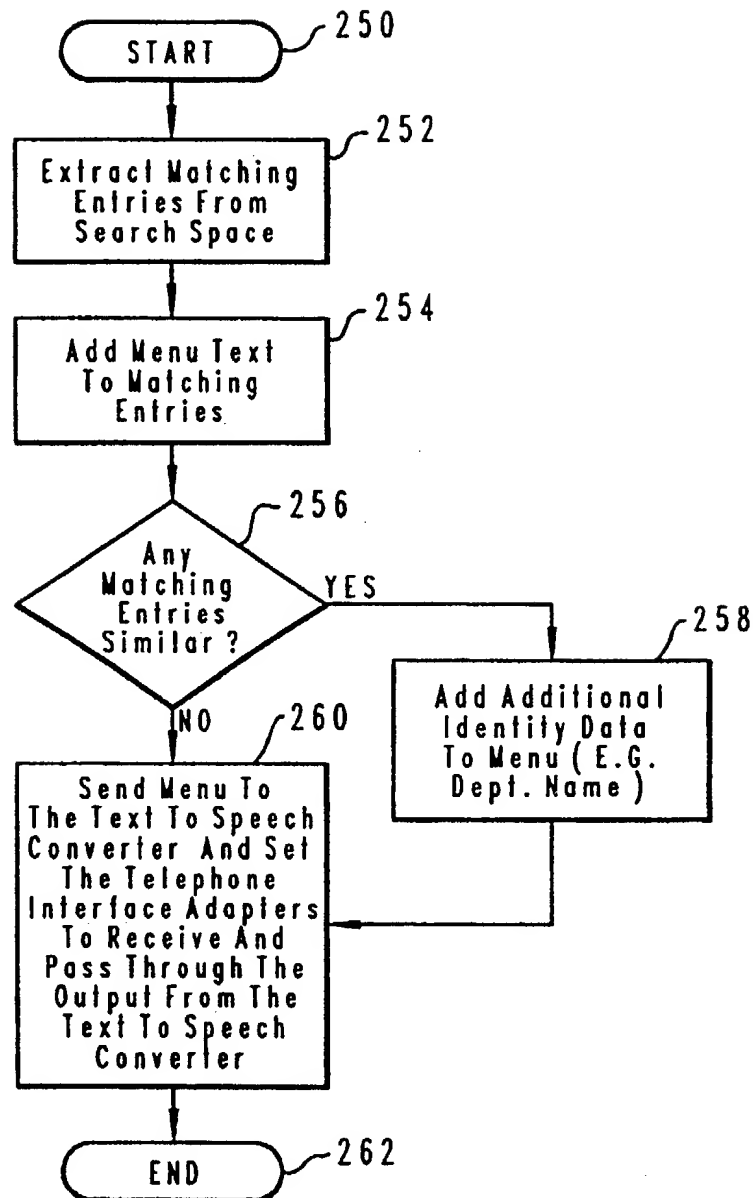


Fig. 3

*Fig. 4*

# METHOD AND SYSTEM FOR PROGRESSIVE DATABASE SEARCH TERMINATION AND DYNAMIC INFORMATION PRESENTATION UTILIZING TELEPHONE KEYPAD INPUT

## BACKGROUND OF THE INVENTION

### 1. Technical Field

The present invention relates in general to an improved method and system for accessing a database and in particular, to an improved method and system for accessing a database utilizing a telephone device. Still more particularly, the present invention provides an improved method and system for accessing a database with a telephone device through an progressive search termination system.

### 2. Description of the Related Art

Typically, data processing systems connected to a database may provide information to remote locations through a telephone communications network, connecting the data processing system and a telephone device at the remote location. The telephone device located at a remote location typically contains a telephone keypad, which has individually depressible alpha-numeric keys. Each alpha-numeric key represents a single number and a plurality of letters of the alphabet. For example, the number "2" alpha-numeric key also represents the alphabetical letters "A", "B", and "C", and the number "3" alpha-numeric key represents the alphabetical letters "D", "E", and "F". A query may be formulated by manipulating these individually depressible alpha-numeric keys in a selected sequence in order to transmit questions and requests for information from the remotely located database. In response to receiving a query from a user at a telephone device, known data processing systems search the database and provide a response utilizing a synthesized voice that is transmitted to the user via the telephone device. "Synthesized voice" means digital to analogue playback of a pre-recorded human voice. Typically, the content of these responses is restricted to pre-recorded segments, and their composition is likewise typically fixed.

This type of system for retrieving information from a remote database utilizing a telephone device is adequate in those cases where the user enters a query requiring only numerical input. In cases where alphabetical input is utilized, retrieval of information may be more problematic since each dual-tone multifrequency ("DTMF") tone represents multiple alphabetical characters. For example, in a directory type database, a user's input may generate numerous entries which correspond to the sequence of keys entered by the user at the telephone device, since each key represents multiple alphabetical characters. After entering a fixed-length query, these multiple entries are typically presented to the user in some manner, allowing the user to choose an entry. Or, alternatively, the user is forced to continue entering the query until the item of choice is uniquely identified, which requires many keystrokes.

Occasionally after entering a query, the user may desire to change or abandon the query; however, the user must generally give control to the system and e.g.; wait until all the corresponding entries are found by the data processing system and presented via the telephone device. In other cases, the user may wish to determine how many entries matching the query have been found thus far, in order to determine whether or not to continue or to modify the query. When only a few match-

ing entries exist, this is not a problem. In those instances, however, where the entries corresponding to a user's query are numerous, i.e., 10, 20, 30, or 40 entries, presenting these entries before allowing modifications to the user's query becomes very cumbersome and unwieldy.

Consequently, it would be desirable to have an improved method and system for providing a user access to a database utilizing a telephone device without subjecting the user to an unwanted presentation of large numbers of entries corresponding to the user's fixed-length query, or forcing the user to enter many keystrokes to uniquely identify the desired item.

## SUMMARY OF THE INVENTION

It is therefore one object of the present invention to provide an improved method and system for accessing a database.

It is another object of the present invention to provide an improved method and system for accessing a database utilizing a telephone device.

It is yet another object of the present invention to provide an improved method and system for accessing a database with a telephone device through progressive search termination system.

The foregoing objects are achieved as is now described. A method and system are disclosed for searching a remote database utilizing a telephone device which is in communication with a data processing system. The data processing system has access to a remote database and the telephone device includes transmitter components for transmitting dual-tone multifrequency signals in response to a user manipulating a keypad associated with the telephone device. The keypad has individually depressible alpha-numeric keys that may be utilized to generate a query and to send commands to the data processing system. The method of the present invention includes prompting the user to enter a query utilizing the depressible alpha-numeric keys on the keypad. As the query is input from the user, the data processing system searches the database to locate entries within the database corresponding to the current state of the query. As the user enters additional data to modify the query, the database is searched for matching entries corresponding to each modification of the query entered by the user. The user might or might not be prompted for each modification of the query. These steps of modifying the query and performing a search based on the modified query are repeated until the matching entries found are less than some predetermined number. At any time during the process an early termination command generated by the user may be utilized to immediately terminate the process. Additionally, in response to the number of matching entries being less than the predetermined number or in response to receiving the early termination command, matching entries may be presented to the user via the telephone device.

Alternatively, in response to an early termination command, the data processing system may present the number of matching entries found, if the number of entries are not less than a predetermined number. The user may thereafter be prompted to continue narrowing the query.

The above as well as additional objects, features, and advantages of the present invention will become apparent in the following detailed written description.

## BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIG. 1 depicts a high level block diagram of a system constructed in accordance with a preferred embodiment of the present invention;

FIG. 2 is a high level logic flowchart of a progressive database search termination with menu method for searching a personnel directory database;

FIG. 3 depicts a high level logic flowchart of the process utilized for location identification and for name identification in the personnel directory database illustrated in FIG. 2; and

FIG. 4 is a high level logic flowchart illustrating the creation and audible presentation of a menu of entries and retrieval of a user's selection in the personnel directory database illustrated in FIG. 3.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

With reference now to the figures and in particular with reference to FIG. 1, there is depicted a high level block diagram of a system constructed in accordance with a preferred embodiment of the present invention. As illustrated, a user may employ telephone device 100 to access data processing system 102. Telephone device 100 is preferably a standard DTMF Touch-Tone telephone. Touch-Tone is a registered trademark of American Telephone and Telegraph Company. Communication between telephone device 100 and data processing system 102 is provided by telephone network 104.

Data processing system 102 also includes telephone interface adapter 106, which is utilized to receive transmissions from telephone device 100 traveling through telephone network 104. Data processing system 102 may be a so called "personal" computer such as a PS/2 computer, or some other computer. PS/2 is a registered trademark of International Business Machines Corporation. Upon receiving a DTMF transmission or a query from telephone device 100, telephone interface adapter 106 relays the query to application 108, which performs various functions including user interface, directory file searching, interface adapter control, and text menu creation.

Application 108 may access directory data files 110 located in data processing system 102 in order to search for entries corresponding to the query sent by user at telephone device 100. Directory data files 110 may be stored within data processing system 102 in a mass storage device such as a hard disk drive. Additionally, directory data files 110 may be updated with additional information from, e.g., host-based directory data files 112 located in a mass storage device outside of data processing system 102. Host-based directory data files 112 may be modified by data conversion application 114 into a format usable by application 108. For example, data conversion application 114 may code the data into DTMF number sequences.

Entries corresponding to the user's query may be sent by application 108 through telephone interface adapter 106 and telephone network 104 to the user at telephone device 100. These entries are presented to the user in an

audible form. This auditory presentation may be accomplished by utilizing messages located in prerecorded voice database 116, which contains a predefined set of messages stored in this database. In addition or alternatively, entries corresponding to the user's query found by searching directory data files 108 may be audibly presented to the user at telephone device 100 by directly converting selected data fields in the entries, e.g., name field or department field, from a text format to a speech format at text-to-speech converter 118.

Referring now to FIG. 2, there is depicted a high level logic flowchart of a progressive database search termination with menu method for searching a personnel directory database. As illustrated, the process begins in block 150 and thereafter proceeds to block 152, which depicts the answering of a telephone call originating from a user utilizing a telephone device at a remote location. Next, block 154 illustrates location identification. This identification involves determining the location that the user desires to access. For example, the user may be trying to obtain the phone number of a person located in Atlanta, Ga. To identify the desired location, the user would manipulate the alpha-numeric keys located on the keypad of the telephone device to indicate the location.

The data processing system would receive the query entered through keystrokes by the user manipulating individually depressible alpha-numeric keys in the form of DTMF tones and audibly provide the user with a menu containing the entries found corresponding to the user's query, allowing the user to choose the desired entry from a list or menu of entries corresponding to the user's query. A query may be one keystroke or an entire field formed by a number of keystrokes. Modifying a query involves either entering additional keystrokes to a data field, adding data fields, or changing existing data fields. This process is described in more detail in FIG. 3. Thereafter, the process proceeds to block 156, which depicts name identification, which involves determining the person who the user wishes to contact. This block is also described in more detail in FIG. 3.

Subsequently after the location and name are identified, the process proceeds to block 158, which illustrates a determination by the user of what action is taken, e.g., whether or not to transfer the call to the person identified or have the phone number audibly read to the user. These choices are presented to the user in the form of an audible menu. If the user chooses to transfer the call to the person identified, the process then proceeds to block 160, which depicts the transferring of the call. After transferring the call, the process terminates as illustrated in block 162.

Referring back to block 158, if the user chooses to have the phone number audibly read, the process then proceeds to block 164, which depicts the data processing system audibly presenting the phone number to the user at the telephone device. In accordance with a preferred embodiment of the present invention, the phone number may be presented to the user utilizing a text-to-speech convertor as the delivery mechanism. Alternatively, the phone number may be presented in an audible fashion to the user by utilizing prerecorded segments arranged in a manner such that the phone number may be presented to the user at the telephone device. Thereafter, the process returns to block 158. Referring again to block 158, if the user chooses the terminate option from the menu, the process terminates as depicted in block 162.

With reference now to FIG. 3, there is depicted a high level logic flowchart of the process utilized in block 154 for location identification and in block 156 for name identification. Both location and name identification follow the same process in the depicted embodiment.

In location identification, the user manipulates the alpha-numeric keys to indicate the location that the user desires to access. For example, if a user desires to find a person in Massachusetts, the data processing system would prompt the user to enter the state desired. The user would begin entering the requested information by pressing the alpha-numeric key 6 to transmit a DTMF tone. This key represents the alphabetical characters "M", "N", and "O". Upon receiving the DTMF tone generated by this key, the data processing system determines that the following states fall into this entry: Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, and Oregon. In a preferred embodiment of the present invention, the data processing system awaits another DTMF tone signal in order to narrow down the number of entries to less than seven.

When the user enters the "2" key, representing the alphabetical characters "A", "B", and "C", the number of entries corresponding to the user's query are reduced to: Maine, Maryland, and Massachusetts. If the user chooses to terminate the search at this point, these entries are audibly presented to the user in a menu form: "Three states match your input: for Maine press 1, for Maryland press 2, for Massachusetts press 3." The user would press "3" to choose Massachusetts. Alternatively, postal abbreviations may be used to select states.

The query in this example is made by a single key stroke transmitting a DTMF tone. The query is modified by pressing another alpha-numeric key. In an alternative embodiment a query may be an entire data field, i.e., multiple key strokes, that may be modified by changing the data field entered or adding another data field.

As illustrated, the process begins in block 200 and thereafter proceeds to block 202, which depicts the initialization of the search space. In initializing the search space, the data processing system sets aside space or memory needed to perform searching and to store the results from searching the database for entries corresponding to the query presented by a user. Entries include, for example, items, records, data fields, or files found in the database that correspond or fit the query presented by a user. For example, the locations: Maine, Maryland, and Massachusetts from the above described example are entries corresponding to the user's query. The process then proceeds to block 203, which illustrates an initial prompt to the user for input.

Next, the process proceeds to block 204, which illustrates the obtaining of the DTMF tone entered by the user at the telephone device. The process will wait at block 204 for a DTMF tone to be entered by the user for a predetermined amount of time; e.g., 6 seconds. If the user enters the DTMF tone prior to the predetermined amount of time, the process continues, without any further delay, to block 206, which depicts a determination of whether or not a "time-out on wait" exists. A "time-out on wait" exists in accordance with a preferred embodiment of the present invention if the user

has not entered a DTMF tone within the predetermined amount of time.

If a "time-out on wait" does exist, the process then proceeds to block 208, which illustrates a determination of whether or not the search space entries are greater than six, i.e., the number of entries found when the user pressed the "6" key in the example above. It will be apparent to those of ordinary skill in the art that various numbers may be utilized in this determination other than six entries. If six entries do not exist, the process then proceeds to block 210, which depicts prompting the user to press the termination key to receive the menu of entries found by the search. For example, the data processing system may utilize synthetic speech to prompt the user to press the "#" key on the keypad. Thereafter, the process returns to block 204.

Referring back to block 208, if the number of search space entries are greater than six, the process then proceeds to block 212, which illustrates reporting the number of matches and prompting the user for additional DTMF tone input. For example, the data processing system may prompt the user to enter data utilizing a prerecorded message such as: "Currently, 10 states match your input. Please continue to enter the next letter of the state you wish to access." Alternatively, the process may prompt the user to continue entering data by tone or beep. Thereafter, the process returns to block 204.

Referring back to block 206, if a time-out on wait does not exist, the process then proceeds to block 214, which depicts a determination of whether or not the termination key has been pressed by the user. If the termination key has been pressed by the user, the process then proceeds to block 216, which illustrates a determination of whether or not the number of search space entries are greater than six. If the number of search space entries are greater than six, the process then proceeds to block 212, which depicts the reporting of the number of matches and prompting the user for additional DTMF tone input. Thereafter, the process returns to block 204.

Referring back to block 216, if the number of search space entries are not greater than six, the process then proceeds to block 218, which depicts the creating and reading of a menu of entries corresponding to the user's query and the retrieval of the user's selection. Thereafter, the process proceeds to block 220, which illustrates the providing of feedback on the item selected to the user and then returning of the one location/name found to the main menu program. The process then terminates as depicted in block 222.

Referring back to block 214, if the termination key has not been pressed by the user, the process then proceeds to block 224, which illustrates reducing the search space based on the DTMF tone entered by the user. Block 226 depicts a determination of whether or not the number search space entries are greater than one. If search space entries are greater than one, the process returns to block 204. If search space entries are not greater than one, the process then proceeds to block 228, which illustrates a determination of whether or not the number of search space entries are equal to one.

If search space entries are not equal to one, the process then proceeds to block 230, which depicts zero locations/names match the user's query and returns an error to the user and restarts the location/name identification process at block 202.

Referring back to block 228, if it is determined that the number of search space entries are equal to one, one location/name has been found and the process then proceeds to block 220, which illustrates the feedback to the user on the selected item and the returning of that one location or name entry to the main menu program. Thereafter, the process terminates as depicted in block 222.

The depicted embodiment will prompt the user for additional input if the user presses the termination key and more than six entries exist. In another preferred embodiment of the present invention, in response to the user pressing the termination key, the process may automatically present the entries to the user even though more than six entries have been found. In such an embodiment, if the data processing system determined that the termination key has been pressed in block 214, the process proceeds to block 218, which depicts the creation and reading of a menu of entries found and retrieving the user's selection. In this embodiment block 216 would be eliminated.

Alternatively, the data processing system may audibly tell the user how many entries were found and give the user a choice as to whether to continue narrowing the search or to present all the entries found thus far in accordance with a preferred embodiment of the present invention.

Referring now to FIG. 4, there is depicted a high level logic flowchart illustrating the creation and audible presentation of a menu listing the entries and retrieving a user's selection as illustrated in block 218 in FIG. 3. The menus, the output, and the prompts audibly presented to a user are all dynamically produced according to data or input received from the user. As depicted, the process begins in block 250 and thereafter proceeds to block 252, which illustrates the extraction of name fields from entries corresponding to the user's query from the search space. Thereafter, the process proceeds to block 254, which depicts the addition of menu text to entries extracted. Menu text is text placed around an entry for audible presentation to the user through text to speech conversion. For example, speech conversion of the name field in the extracted entry, John Smith, and the menu text would be audibly presented to the user at the telephone device as "For John Smith, please press 1". The menu text added to the name field in this example are the words "For" and "please press 1".

Next, after adding the menu text to the name fields of matching entries, the process proceeds to block 256, which illustrates a determination of whether or not any of the name fields in extracted entries are similar. In some cases, the name fields from extracted entries may be similar. For example, two John Smiths may be located at the same site. If extracted name fields are similar, the process then proceeds to block 258, which depicts adding additional identity data to the menu to differentiate the entries. For example, department names from the department fields of the entries could be added to distinguish between multiple similar entries. The menu audibly presented through text to speech conversion to the user would, for example, be as follows: "For John Smith in Marketing, please press 1; for John Smith in Production, please press 2". In this example, the two entries were identical. The same procedure would be employed for similar entries such as William Smith and Will Smith. In accordance with a preferred embodiment of the present invention, the above-

described menu is dynamically produced depending on the data entered by a user.

After audibly presenting the menu to the user, the process proceeds to block 260, which illustrates the sending of the menu to the text-to-speech converter and the setting of the telephone interface adapters to receive and pass through the output from the text-to-speech converter to the user at the telephone device. Thereafter, the process terminates as depicted in block 262. It will be apparent to those of ordinary skill in the art that other methods of transferring output from a text-to-speech converter to the user may be utilized.

One advantage of the embodiment described above is that it provides a progressive database search termination method for interpreting and utilizing keypad input of an alpha-numeric nature. In accordance with a preferred embodiment of the present invention, the present method and system operates by utilizing a search space, which is successively reduced as the user enters more input. Furthermore, at any point during input in accordance with a preferred embodiment of the present invention, the user may press a termination key (e.g. the "#" key) on the keypad to terminate the search process. In response to a termination command, an auditory message will inform the user of a number of entries found for the entered search string, or in the case in which six or fewer entries are present, an auditory menu may be presented to the user. Alternatively, the data processing system may audibly present all of the entries found thus far to the user without checking the number of entries found. Importantly, the user is able to terminate the search at any point in time in accordance with a preferred embodiment of the present invention. Additionally, the described embodiment depicts the implementation of dynamic content and composition of, e.g., output, menus, and prompts to the user.

Additionally, although the presently described embodiment depicts the searching for name and location identities in a personal directory, the method and system in accordance with a preferred embodiment of the present invention may be utilized to search any database, which may be indexed utilizing alpha-numeric input.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A method for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said method comprising:

- (a) prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;
- (b) searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system;

- (c) prompting said user to enter additional data to modify said query;
- (d) searching said database for entries corresponding to said query as modified by said additional data entered by said user, wherein a number of entries 5 are located;
- (e) repeating steps (c) through (d) until said number of entries is less than a predetermined number;
- (f) in response to receiving an early termination command generated by said user, terminating steps (c) 10 through (e); and
- (g) in response to said number of entries being less than a predetermined number or receiving said early termination command, audibly presenting said entries to said user via said telephone device. 15

2. The method of claim 1 wherein said step of audibly presenting said entries to said user via said telephone device includes converting the entries from text to speech.

3. A method for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals 25 are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said method comprising:

- (a) prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;
- (b) searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system;
- (c) prompting said user to enter additional data to modify said query;
- (d) searching said database for entries corresponding to said query as modified by said additional data entered by said user, wherein a number of entries are located;
- (e) repeating steps (c) through (d) until said number of entries is less than 7;
- (f) in response to receiving an early termination command generated by said user, terminating steps (c) through (e); and
- (g) in response to said number of entries being less than 7 or receiving said early termination command, audibly presenting said entries to said user via said telephone device, wherein said step of audibly presenting said entries to said user via said telephone device includes converting the entries from text to speech. 55

4. The method of claim 2, wherein said step of prompting said user to enter additional data includes waiting for a selected period of time for additional data to be entered by said user and if additional data has not been entered, audibly prompting said user to enter additional data after said period of time. 60

5. A method for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associ-

ated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said method comprising:

- (a) prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;
- (b) searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system;
- (c) prompting said user to enter additional data to modify said query;
- (d) searching said database for entries corresponding to said query as modified by said additional data entered by said user, wherein a number of entries are located;
- (e) repeating steps (c) through (d) until said number of entries is less than a predetermined number;
- (f) in response to receiving an early termination command generated by said user, terminating steps (c) through (e); and
- (g) in response to said number of entries being less than a predetermined number or receiving said early termination command, audibly presenting said entries to said user via said telephone device, wherein said step of audibly presenting said entries to said user via said telephone device includes converting the entries from text to speech;

wherein each entry has a plurality of data fields contained therein, wherein each data field contains text, and said step of audibly presenting said entries to said user comprises dynamically creating a menu utilizing text from selected data fields in said entries found during said step of searching said database for entries corresponding to said query as modified, and audibly presenting said menu to said user by converting said text to speech.

6. A method for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said method comprising:

- (a) prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;
- (b) searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system;
- (c) prompting said user to enter additional data to modify said query;
- (d) searching said database for entries corresponding to said query as modified by said additional data entered by said user, wherein a number of entries are located;
- (e) repeating steps (c) through (d) until said number of entries is less than a predetermined number;
- (f) in response to receiving an early termination command generated by said user, terminating steps (c) through (e); and

(g) in response to said number of entries being less than a predetermined number or receiving said early termination command, audibly presenting said entries to said user via said telephone device, wherein said step of audibly presenting said entries to said user via said telephone device includes converting the entries from text to speech; wherein each entry has a plurality of data fields contained therein, wherein each data field contains text, and wherein said presenting step comprises dynamically creating a menu utilizing text from selected data fields in said entries found during said searching step; in response to a presence of identical data in said selected data fields for said entries in said menu, adding text from additional data fields from said entries that include identical data in said selected data fields to said menu to produce a modified menu that distinguishes said entries having identical data in said selected data fields in said menu; and audibly presenting said modified menu to said user utilizing a text to speech conversion.

7. A method for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said method comprising:

- (a) prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;
- (b) searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system;
- (c) prompting said user to enter additional data to modify said query;
- (d) searching said database for entries corresponding to said query as modified by said additional data entered by said user, wherein a number of entries are located;
- (e) repeating steps (c) through (d) until said number of entries is less than a predetermined number;
- (f) in response to receiving an early termination command generated by said user, terminating steps (c) through (e); and
- (g) in response to said number of entries being less than a predetermined number or receiving said early termination command, audibly presenting said entries to said user via said telephone device, wherein said step of audibly presenting said entries to said user via said telephone device includes converting the entries from text to speech; wherein said step of prompting said user to enter additional data includes dynamically creating a menu of choices based on entries found and presenting said menu of choices to said user utilizing a text to speech conversion.

8. A method for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associ-

ated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said method comprising:

- (a) prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;
- (b) searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system;
- (c) prompting said user to enter additional data to modify said query;
- (d) searching said database for entries corresponding to said query as modified by said additional data entered by said user, wherein a number of entries are located;
- (e) repeating steps (c) through (d) until said number of entries is less than a predetermined number, wherein said entries are audibly presented to said user via said telephone device; and
- (f) in response to receiving an early termination command generated by said user, terminating steps (c) through (e) and audibly presenting said entries to said user.

9. The method of claim 8 further comprising: in response to receiving said early termination command, audibly presenting said entries to said user via said telephone device.

10. A method for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said method comprising:

- (a) prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;
- (b) searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system;
- (c) prompting said user to enter additional data to modify said query;
- (d) searching said database for entries corresponding to said query as modified by said additional data entered by said user, wherein a number of entries are located;
- (e) repeating steps (c) through (d) until said number of entries is less than a predetermined number, wherein said entries are audibly presented to said user via said telephone device;
- (f) in response to receiving an early termination command generated by said user, terminating steps (c) through (e);
- (g) in response to receiving said early termination command and if said number of entries is greater than or equal to said predetermined number, presenting said number of entries to said user and prompting said user to choose between modifying said query and audibly receiving said entries via said telephone device; and



(h) in response to receiving said early termination command and if said number of entries is less than said predetermined number, audibly presenting said entries to said user via said telephone device.

11. The method of claim 10, wherein said predetermined number is 7.

12. A data processing system for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said data processing system comprising:

means for prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;

first searching means for searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system, wherein a number of entries from within said database are located and said first search means may be terminated in response to receiving an early termination command generated by said user;

means for prompting said user to enter additional data to modify said query;

second searching means for searching said database for entries corresponding to said query as modified by said additional data entered by said user until said number of entries is less than a predetermined number;

means for terminating said second searching means in response receiving to an early termination command generated by said user; and

means for audibly presenting said number of entries to said user via said telephone device in response to said number of entries being less than a predetermined number or receiving said early termination command.

13. The data processing system of claim 12 wherein said means for audibly presenting said entries to said user via said telephone device includes means for converting said entries to audible speech.

14. A data processing system for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said data processing system comprising:

means for prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;

first searching means for searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system, wherein a number of entries from within said database are located;

means for prompting said user to enter additional data to modify said query;

second searching means for searching said database for entries corresponding to said query as modified by said additional data entered by said user until said number of entries is less than 7;

means for terminating said first and second searching means in response receiving to an early termination command generated by said user; and

means for audibly presenting said number of entries to said user via said telephone device in response to said number of entries being less than 7 or receiving said early termination command, wherein said means for audibly presenting said entries to said user via said telephone device includes means for converting said entries to audible speech.

15. The data processing system of claim 12, wherein said means for prompting includes means for waiting for a selected period of time for additional data to be entered by said user and if additional data has not been entered, means for audibly prompting said user to enter additional data after said period of time.

16. A data processing system for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said data processing system comprising:

means for prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;

first searching means for searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system, wherein a number of entries from within said database are located;

means for prompting said user to enter additional data to modify said query;

second searching means for searching said database for entries corresponding to said query as modified by said additional data entered by said user until said number of entries is less than a predetermined number;

means for terminating said first and second searching means in response receiving to an early termination command generated by said user; and

means for audibly presenting said number of entries to said user via said telephone device in response to said number of entries being less than a predetermined number or receiving said early termination command;

wherein each entry has a plurality of data fields contained therein, wherein each data field contains text, and said means for audibly presenting comprises means for dynamically creating a menu utilizing text from selected data fields in said entries found by said means for searching, and means for audibly presenting said menu to said user by converting said text to speech.

17. A data processing system for searching a database utilizing a telephone device in communication with a data processing system, said data processing system

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having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said data processing system comprising:

means for prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;

first searching means for searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system, wherein a number of entries from within said database are located;

means for prompting said user to enter additional data to modify said query;

second searching means for searching said database for entries corresponding to said query as modified by said additional data entered by said user until said number of entries is less than a predetermined number;

means for terminating said first and second searching means in response receiving to an early termination command generated by said user; and

means for audibly presenting said number of entries to said user via said telephone device in response to said number of entries being less than a predetermined number or receiving said early termination command;

wherein each entry has a plurality of data fields contained therein, wherein each data field contains text, and wherein said means for presenting comprises means for dynamically creating a menu utilizing text from selected data fields in said entries found by said second searching means; in response to a presence of identical data in said selected data fields in entries in said menu, means for adding text from additional data fields from said entries having identical data in said selected data fields to said menu to produce a modified menu that distinguishes said entries having identical data in said selected data fields in said menu; and means for audibly presenting said modified menu to said user utilizing a text to speech conversion.

18. A data processing system for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said data processing system comprising:

means for prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;

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means for searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system, wherein a number of entries are located;

means for prompting said user to enter additional data to modify said query;

means for searching said database for entries corresponding to said query as modified by said additional data entered by said user until said number of entries is less than a predetermined number, wherein said entries are audibly presented to said user via said telephone device; and

means for terminating either searching means in response to receiving an early termination command generated by said user and for audibly presenting said entries to said user.

19. The system of claim 18 further comprising:

means for audibly presenting said entries to said user via said telephone device, in response to receiving said early termination command.

20. A data processing system for searching a database utilizing a telephone device in communication with a data processing system, said data processing system having access to said database, said telephone device having transmitter components for transmitting dual-tone multifrequency signals, wherein said dual-tone multifrequency signals are generated by a user manipulating a keypad associated with said telephone device, said keypad having a plurality of individually depressible alpha-numeric keys to generate a query and to send commands to said data processing system, said data processing system comprising:

means for prompting said user to enter a query utilizing said plurality of individually depressible alpha-numeric keys on said keypad;

first searching means for searching said database to locate entries within said database corresponding to said query in response to receiving said query at said data processing system, wherein a number of entries are located;

means for prompting said user to enter additional data to modify said query;

second searching means for searching said database for entries corresponding to said query as modified by said additional data entered by said user until said number of entries is less than a predetermined number;

means for terminating said second searching means in response to receiving an early termination command generated by said user;

means for audibly presenting said number of entries to said user and prompting said user to choose between modifying said query and audibly receiving said entries via said telephone device, in response to receiving said early termination command and if said number of entries is greater than or equal to said predetermined number; and

means for audibly presenting said entries to said user via said telephone device in response to receiving said early termination command and if said number of entries is less than said predetermined number.

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